The Green Thumb

Spring 1981 Vol. Thirty-eight

Number One

The Cover
The Margaret E. Honnen Orchid Bromeliad Pavilion

The Green Thumb
Spring 1981
Vol. Thirty-eight, Number One

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Organization. Membership fees are as follows: Classes of Membership — Individual student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Bota Gardens, Inc. you will receive *The Gree Thumb* and the monthly *Newsletter*. Yo will also have unlimited access to the u the books in the Helen K. Fowler Librai located in Boettcher Memorial Center a 1005 York Street.

For further information write to Membership Chairman, Botanic Garde House, 909 York Street, Denver, Colora 80206, or call 575-2547.

'he Green Thumb

Spring 1981

'illiam H. Anderson, Jr.
ilberta T. Anderson
ditors

'ontents

Denver Botanic Gardens, Inc. maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Orchid Bromeliad Pavilion Dedicated

William H. Anderson, Jr.

"My name is Richard A. Kirk and currently I serve as President of the Board of Trustees of the Denver Botanic Gardens. We are delighted to have all of you here today for this very exciting event — the Dedication of the Margaret E. Honnen Orchid Bromeliad Pavilion in honor and recognition of Marnie Honnen." These words were spoken by Mr. Kirk Wednesday, January 14, 1981 as he opened the Dedication ceremony for the almost completed facility. It will not be open to the public until June 1981.

Mr. Kirk went on to say, "Mrs. Honnen was one of the original founders of Denver Botanic Gardens and served as a Trustee from 1958 through 1974 when she officially became a life trustee. Over the years she developed countless friends here at board, staff, and community levels. She was a leader, a worker and an inspiration to all of us. She was a true lady in every respect and she knew her flowers. She served on numerous committees, helped raise money and made things happen. As a board and an organization we are very careful as to how we bestow memorials and name recognition but in the case of Marnie Honnen all of us unanimously wanted to recognize her fo her splendid leadership and contribution.

"A building of this nature doesn't just happen. People bring it about. John Mitchell, as former President, helped guide us to where we are. Dr. Bill Gambill provided valued leadership. Vic Hornbein masterminded the archi tectural design and Bill Mead the construction finesse. Our trustee, Bill Thurston, had a major interes — numerous people and companie contributed broadly and as outlined on your program some speci fically to this great pavilion. And certainly the Edward H. Honnen family were motivators in bringing us to this day. With the future ahead of us, I've asked Merle Moore, our Director, to take a few minutes to tell us what we have and where we are headed."

Mr. Moore made the following comments:

"In 1976, the Botanic Gardens wa the recipient of a major private

ollection of bromeliads totalling ver 1,000 plants, donated by Mrs. Valter R. Smith of New Orleans, Louisiana, in memory of her late husband. With the encouragement and support of Conservatory and Greenhouse Superintendent, Andrew Pierce, and through the interest and horticultural skill of Gary Davis, Gardener-Florist, who has been in charge of caring for and developing the collection, it has grown today to 1,865 plants representing 44 genera and 1,217 taxa.

"The Orchid Collection, under the capable development of Larry Latta, Botanist-Horticulturist, and with the considerable assistance of Bill Thurston, has also steadily increased in numbers and importance during this same time period. Today there are over 1,700 orchids in our collection, representing 1,100 taxa.

"Most of the plants in these collections have been on display irregularly and infrequently, being housed in greenhouses not generally open to the public. However, with construction of the Margaret E. Honnen Orchid Bromeliad Pavilion completed, a dramatic alteration in the use of these plants for public education and enjoyment will occur. We are dedicating here today far more than 3
an architectural achievement. We are dedicating a commitment to educational opportunities for present and future generations. We are dedicating an 'environment' in which visitors to the Botanic Gardens can observe, study and enjoy rare and beautiful tropical plants they may otherwise never see in their entire lifetime. To the

Ribbon Cutting Ceremony Dedication Orchid Bromeliad Pavilion

thousands of school children who come to the Gardens each year, 'Marnie's Pavilion' will make some of the plant world's most exotic, unusual and fascinating subjects available — not necessarily so the children can memorize their Latin names or demanding cultural requirements but to simply instill in those children a sense of wonder, an inquisitiveness about our natural world.

4 "Speaking for the entire staff of the Denver Botanic Gardens, we are deeply indebted to Edward H. Honnen and the other contributors to the Margaret E. Honnen Orchid Bromeliad Pavilion for giving us this beautiful facility with which to work. We will make every effort to keep the promise that has been fulfilled here today."

Mr. Edward H. Honnen was then introduced by the President. He spoke briefly of the real interest and affection for the Denver Botanic Gardens shown by Mrs. Honnen. He read the following poem:

"A Beautiful Spirit entered our
lives filled with Love, Patience
and Understanding.
Graciously and unselfishly per-
meating itself until life fulfillment.
Tenderly dispersing the fruits of
affection to family and friends —
there were no strangers.
May this beautiful structure typify
and preserve the memory of this
lovely spirit."

Mr. Kirk then said, "Next, as is customary with the near completion of Marnie's Pavilion, we would like to present the building to the City and County of Denver with the Mayor accepting in behalf of the City."

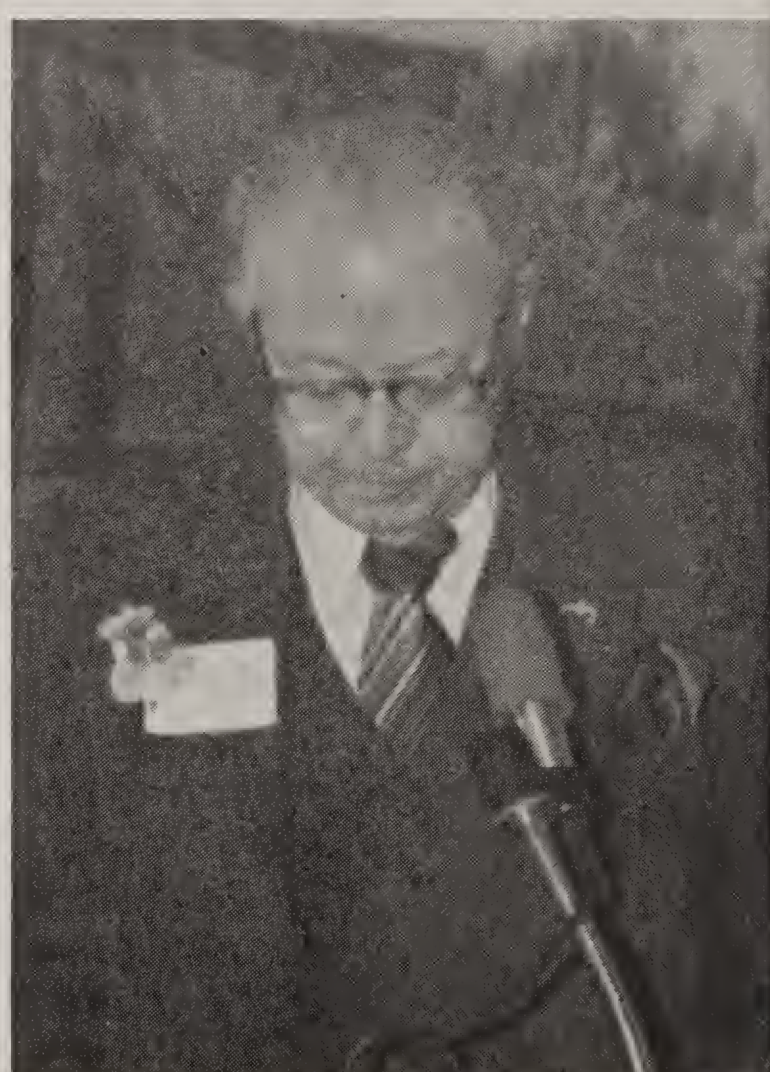
His Honor W. H. McNichols, Jr. in accepting the Pavilion for the City and County of Denver said:

"This is more than a ribbon-cutting — it's a major and beautiful addition to these lovely gardens.

"As Mayor of this great Mile High City, I'm proud of everyone, and there were many who helped make this moment possible. But the Honnens, all of them, are the center of today's happening.

"It is fitting indeed that this lovely and delicate flower will be grown here — a constant reminder to all who visit this Pavilion of Marnie Honnen and her many-faceted contributions to these things of beauty for all of us to enjoy in future years. These Gardens — this Pavilion will be a continuing reminder of Marnie and her legacy to us.

"Thank you very much."



Honorable William H. McNichols, Jr., Mayor Speaking at the Dedication

Edward H. Honnen, Speaking at the Dedication

Assembled in the Pavilion were members of the Honnen family as well as other relatives of Mrs. Honnen, Trustee of the Denver Botanic Gardens, and many generous persons whose contributions helped to make the construction of the Pavilion possible.

The still not completed Pavilion will not be open to the public until June 1981.

The Board of Trustees of Denver Botanic Gardens gratefully acknowledges the donations of the following public spirited citizens who contributed so generously to the campaign "To Fulfill a Promise," and whose gifts were restricted to fulfilling a promise for the Orchid Bromeliad Pavilion.

Anonymous
Mr. and Mrs. George G. Anderman
Mr. and Mrs. Keith Anderson
Mr. Walter K. Arbuckle
Mr. and Mrs. Hubert L. Barbe
in memory of Emily L. Barbe
Mr. and Mrs. Rollin Barnard
Crestmoor Gardeners
Crestmoor Park Garden Club
El Pomar Foundation
Mr. and Mrs. Paul W. Fullerton
Happy Transplant Garden Club

Edward H. Honnen
Mr. and Mrs. Edward B. Horton
in memory of Margaret B. Horton
Mrs. Hugh M. Kingery
Mr. Larry Latta
Midland Federal Savings and Loan
Mrs. Elaine A. Pelletier
Estate of Bertha M. Roessner
Jessie & Nellie Shwayder, Inc.
Dr. and Mrs. John M. Stewart
Mr. and Mrs. William R. Thurston
Western Crude Oil Inc.

Poison In Our Plants

Emily Tufts

Editor's note: Emily Tufts, M.D. writes "I am a medical doctor, not a botanist so I have laid the stress on the toxins in plants. Descriptions of the plants are strictly those of a lay person designed for amateurs."

In this day of enthusiasm for eating wild plants and herbs and "living off the land" a cautionary note is indicated. Many plants contain toxins; these toxins are present in varying concentrations and have differing effects on the body. Allergy further complicates the picture in that some toxins cause trouble only to people who happen to be sensitive to that particular allergen and the non-allergic person is unaffected.

Classifying and arranging in orderly fashion is a human characteristic, so I shall re-arrange plants, not according to accepted botanical criteria, but rather according to their toxic properties. Some toxins are limited to a botanical family, but more often similar toxins are found in plants irrespective of their family tree.

Amygdalen

Amygdalen is an interesting compound found largely in the family *Rosaceae* and specifically in some of our food plants, i.e. apricots and plums. Amygdalen itself is harmless, but when ground and dissolved in intestinal juices it hydrolyses, releasing cyanide. The cyanide is absorbed into the blood stream, is transported throughout the body, and kills body cells. There is an antidote, given only intravenously and available in most hospital emergency rooms.

Amygdalen is present in the pits of cherries, peaches, plums, apricots, apples, wild choke cherries, cherry laurel and in lima beans grown outside the United States.

Dr.Tufts is a specialist in identification of and treatment for poisons. She is connected with the Denver General Poison Control Center and with Colorado University. She is on a sabbatical leave of absence from the Medical School of the University of Oregon.

atura stramonium

hese seeds all have a tough iter shell which provides an ffective protection if the pit is wallowed whole. Under these nditions the pit is considered on-toxic. If the shell is broken id the tender kernel removed, iewed, and swallowed then anide will be released. The dy has its own mechanism for toxifying cyanide so that a few rnels are of no consequence. hen numbers of kernels are round and eaten, then cyanide isoning may occur.

aetrile is similar if not identical amygdalen. Children have ed from cyanide poisoning after ating laetrile pills.

Anticholinergics

Anticholinergic is a medical term which we might as well use. There is a complex automatic nervous system which regulates many functions such as heart rate, blood pressure, temperature, digestion, breathing, pupils of the eye, etc. without our having to think about it. Part of this system is the cholinergic system. Anticholinergic compounds block the cholinergic functions and upset the orderly balance of the system. The main anticholinergic plant found in this country is *Datura stramonium* L. or jimson weed. The victim of this plant is dry as a bone — that is his

mouth and skin are dry — red as a beet, skin flushed, hot as a firecracker — has a fever — and "wild as a march hare". This latter symptom brings up the main problem with jimson weed. It is also an hallucinogen. The deaths which have occurred with jimson weed have been mainly from using the seeds for their psychodelic effect and overdoing it a bit. It has been used as an asthma preparation, but the drying effect is harmful for asthmatics.

Datura stramonium is a bushy weedy plant which grows from 3 feet up to 6 feet tall. It grows in the United States, Europe, and Australia. It has 2 to 6 inch alternate leaves which are widely dentate. In spring it has large white trumpet shaped blooms. The seeds are black and flattened, growing in an ovoid spiny pod. All parts of the plant contain atropine. *Atropa belladonna* Per. or deadly night shade also contains atropine. This particular nightshade is indigenous to Europe and grows only rarely in the United States where it has escaped from cultivation.

Cardiac (Heart) Glycosides

Digitalis purpurea L. or foxglove for years was the main source of digitalis, one of our most valuable medicines to strengthen the heart. Too much digitalis causes serious toxicity. The amount of digitalis in natural leaves is so variable that the strength of the medicinal preparations can't be standardized. The digitalis used now is synthetic and provides standard dosage.

Foxglove is a beautiful and striking plant with its showy spike of bloom, but has a rather nondescript rosette of fuzzy leaves in early spring. The main problem with digitalis poisoning comes when its leaves are confused with comfrey or mullein for making herb teas. There are some pretty foxgloves in the Botanic Gardens.

Nerium oleander L., a showy subtropical shrub or small tree, is grown in Denver as a house plant. There is an example in the Conservatory. It has alternate linear leaves growing directly from the stem and clusters of fragrant white to pink flowers with a tubular corolla. All parts of the plant contain a potent heart stimulant. Deaths have been reported from relatively inconsequential exposures.

There are several members of the heath family which contain andrometoxin, a heart stimulant. Azaleas, rhododendrons, *Kalmia latifola* L., and japonica all contain this toxin. In general small amounts are harmless but poisonings have occurred when large amounts have been eaten, or when teas or extracts of the leaves have been made.

Zygadenus venosus S. Wats. or death camas causes intestinal upset with vomiting, cramps, and diarrhea as well as effects on the heart and blood pressure. The plant is a western wild flower with an onion-like bulb, grass-like leaves, and a cluster of greenish yellow flowers on the top of a stalk. Some of the *Zygadenus* are edible. The history of camas being used as food by the Indians as well as its resemblance to an onion leads people to gather and eat the death camas.

Zigadenus venosus

Mistletoe grows mainly in Christmas decorations. It contains a compound which stimulates the automatic muscles (intestine, bladder, blood vessels, and uterus). Because of its effects on uterine muscle it has been used to cause abortions. Unfortunately it is impossible to control the dose so that the death of the mother as well as of the fetus may occur. Happily, though, the numbers of toddlers and the numbers of mistletoe berries at Christmas have not, to my knowledge, resulted in serious difficulty.

Colchicine

Autumn crocus is no relation to the multicolored spring crocus. Bunches of leaves come up in the spring and die down in summer. In fall the pale lavender crocus-like blooms appear. There are autumn crocus on either side of the entry in front of the main building at the Botanic Gardens. Autumn crocus contains colchicine which is an extremely interesting agent. It is used medically in the treatment of gout. It also affects the chromosomes partition in dividing cells causing tetraploid mutations and development of new plant species. Poisoning may affect all systems of the body. One characteristic of non-fatal poisonings is complete loss of hair. There is no antidote.

Glory lily is a slender vine-like plant. It has a spectacular flower with curved crinkled petals of yellow changing to red. It grows wild in subtropical areas, but in pots in more temperate climates. It also contains colchicine.

Nicotine

We all know about nicotine in tobacco, but there are some wild plants which have nicotine-like effects. Nicotine exerts its effect in the body by stimulating part of the automatic nervous system discussed under anticholinergic plants. It causes vomiting, drooling, weakness to paralysis, and occasionally convulsions. Cigarette butts are dangerous for toddlers. Nicotine itself is used as an insecticide.

The most lethal member of this group is *Conium maculatum* L. or poison hemlock. This is a European plant which has escaped and now grows wild in the United States. It is also reputed to be the plant used to poison Socrates. The entire plant contains conine but the seeds and growing tips are most toxic. This plant and its close botanical (but not toxicologic) relative water hemlock contain potent toxins. The umbelliferae family contains in addition to the two hemlocks such familiar and very similar

plants as parsley, anise, dill, and carrot. Problems with poisoning come usually from confusing the poisonous water hemlock seeds, leaves, or tubers for flavorings with carrots or turnips. Symptoms are of rapid onset, trembling, staggering, weakness, slowed heart, and paralysis. There is a characteristic odor described as "mousey".

The plant is tall, 4 to 10 feet, with feathery parsley-like leaves, a lacy white infloresence followed by seeds resembling dill, and has a carrot-like tap root with white flesh. There are several plants in the Botanic Gardens beside a little woodsy path between the new Alpine Rock Garden and the back fence. Look for purplish spots on the stem which distinguish it from its relatives.

Stimulant Plants

Water hemlock or *Cicuta* is reputed to be the most poisonous plant in the United States. There are several species of *Cicuta* growing in the United States and Europe. The plant is very similar to poison hemlock and is a member of the family *Umbelliferae.* Water hemlock as its name suggests grows along stream sides and in marshy places. Its roots and lower stem are distinctive. The roots begin as a cluster of fleshy tubers and the lower end of the hollow stalk has a series of closely spaced transverse diaphragms.

The tubers are the most poisonous part, and in early spring after high water has uncovered the roots and there is no obscuring foliage the fisherman may be tempted by the carrot. As with poison hemlock there is a "mousey" odor. One or two bites may cause serious or even lethal poisoning. The onset of symptoms is prompt, within 15 minutes or a half hour. The prompt onset of symptoms may indeed save the victim since he may vomit the remaining hemlock before it can be absorbed. If sufficient material is absorbed severe convulsions can result.

Oxalates

Most houseplants are not toxic, but the ones that do have toxic materials with a few exceptions fall into the oxalate category. Oxalates are found in the arum family, in oxalis or sorrel, and in rhubarb. Spinach also contains significant oxalate. The familiar and ubiquitous houseplant *Dieffenbachia* is the most troublesome oxalate producing plant. People occasionally bite into the succulent stem. There is prompt burning of the membranes of the mouth with subsequent swelling. From the pain and swelling the victim is rendered speechless — thus its common name dumbcane. It has been suggested that the oxalate occurs in crystals which penetrate the delicate membranes of the mouth to cause such intense irritation, but there is evidence to suggest that there may be an allergic component also.

Philodendron and sorrel or oxalis also contain oxalates but not to the startling degree that is in dumbcane. It would take a great deal to cause trouble and the trouble would not be local as with dumbcane but generalized toxicity. Oxalate interferes with calcium and also in large amounts can block the kidney tubules.

pg 320

Rhubarb leaves contain large amounts of oxalate and are occasionally eaten by home gardeners who do not realize that only the stem of rhubarb is edible.

Toxalbumin

Toxalbumins are proteins which are caustic and which bind to body cells and interfere with cell function. Like the stimulant type of toxin in water hemlock these toxins are potent. Since they are proteins they may also add an allergic component to their effect. Poisonings with these are fortunately rare.

Castor bean contains ricin. Castor beans are raised commercially for castor oil and people involved in the raising and processing of this crop may become sensitized and irritated but not poisoned by the plant. It is the child who eats the seeds who may be seriously poisoned or killed by one to three seeds. Remember that seeds come in packets as well as on plants. This plant is also grown as an ornamental. It is a large annual shrub, 4 to 15 feet high with large deeply lobed green to reddish leaves. The green to rust colored blossoms are on spikes at the end of branches. The mottled black to grey to brown seeds are borne in pods with fleshy spines.

Jequirity beans grow in the subtropics and arrive in the more temperate zones in the form of costume jewelry and decorations. The small bean is a bright red with a black eye. They are attractive to children who eat the bean. As is true with the beans containing amygdalen if the husk is unbroken the bean may pass through the intestinal tract uneventfully but most of these have been strung as beads and their husks perforated. Poisonings have diminished since customs inspectors are on the watch and try to separate tourists from their toxic treasures and prevent their importation. *Robinia* or black locust contains a similar toxin but not in such concentration as the castor and jequirity beans. This toxin is not in the common honey locust of Denver.

In poisoning due to the toxalbumins there is usually a lag period of hours to a day or two before onset of symptoms. There is a severe intestinal upset followed by a generalized illness with liver and kidney damage, destruction of the blood and nervous system. There is no antidote.

Solanine

Solanine takes its name from the botanical family Solanaceae where it is widely found. Its effects are similar to the anticholinergic agents, and in fact the two toxins may be present in the same plant at different stages of growth. The symptoms from ingestion of solanum may be delayed for several hours and consist of intestial upset, plus weakness, sweating, drooling, fast heartbeat, and fever.

Solanine is found in many plants including green potato shoots and tomato foliage. Poisonings from these sources are rare. The nightshade family and the Christmas plant, Jerusalem cherry, are the main sources of ingestions of solanine in the United States. There are several species of nightshade i.e. *Solanum nigrum* L. and *Solanum dulcamara* L. They are similar and all contain solanine. They are trailing or

woody vines, the small flowers may be white or purple and resemble tomato flowers. The berries are green becoming blue-black when ripe and resemble tiny tomatoes in structure. *Solanum pseudocapsicum* L. or Jerusalem cherry is a small shrubby plant growing in pots with a bright red decorative fruit. There is a specimen in the Conservatory.

Veratrum

Veratrum viride L. is a large 3 to 8 foot single stalked herbaceous plant growing wild along streams and marshy areas. It has large (6 to 12 inch) leaves and a cluster of greenish flowers. The roots and shoots contain veratrum which has been used in the past to control high blood pressure. Poisoning from this plant in addition to dropping the blood pressure may cause intestinal upsets, weakness, low temperature, confusion and convulsions.

Dermatitis

There is much myth and misery associated with the genus *Rhus* — poison oak, ivy, and sumac. The noxious agent is urushiol oil and causes the familiar contact dermatitis in about 2/3 of people who come in contact with it. There is a delay of some 48 hours before the itchy blisters and swelling appear. Washing with soap and water immediately after contact may prevent the spread of the oil on the skin but not after the rash begins to appear. The oil may adhere to clothes, objects, and the fur of pets. Oil may be in droplets in smoke when the plants are burned. Direct contact with the plant is not therefore necessary. The rash, though not serious can become very extensive and very uncomfortable. Cool wet dressings and simple creams should suffice for milder cases. Many cases of poison ivy/oak dermatitis are made worse by over enthusiastic treatment of inflamed skin. More severe cases may require more heroic measures by the family physician.

This article is not intended as a home treatment guide but rather as a matter of interest. When a plant poisoning or questionable ingestion occurs, the victim should resort to his regular provider of medical care or to his poison center for advice.

There are many, many plants which contain toxins which I have not included. I have discussed only a few representative plants in each toxin group. For further reference about specific plants there are many excellent resources. Kingsbury's book on poisonous plants — available in the library at the Botanic Gardens — is probably the most complete. The poison center also has extensive information on whether plants contain poisons.

Cicuta **Sp. Water Hemlock**

Turf/Ground Cover Demonstration Area

Gayle Weinstein

Conservation of energy and natural resources has become of increasing concern. As a result, more emphasis must be placed on turfgrass selections that are best adapted to the soils and climate of our region. Such selections would reduce maintenance costs and the need for expending limited natural resources. Alternatives to turf should also be considered for the same reasons. Turf alternatives offer greater variety, seasonal change, less maintenance, and better utilization of difficult areas.

In response to these concerns and the public's interest, the Turf/Ground Cover Demonstration Area at the Denver Botanic Gardens was revamped from March through September 1980.

Presently, this area is divided into six sections: one composed of cool season grasses to be grown under optimum conditions; another comprised of dryland varieties, also grown optimally. For comparison, a third section combines both cool season and dryland selections to be grown under reduced maintenance.

Gayle Weinstein is a Botanist-Horticulturist at the Denver Botanic Gardens. She is concerned mainly with the outside horticulture of the gardens.

In addition, two areas consist of ground covers for sun, shade, or both. The last division features nonplant ground covers and mulches along with a display of weeds common to turf and/or cultivated beds.

We feel that communication with the public regarding this area is highly valuable. Any suggestions, comments, or experience that could be shared to increase our information will be appreciated.

SECTION I: This area consists of cool land warm season grasses with low water requirements (dryland grasses). Cool season grasses' optimum growing temperature is 60 to 75 degrees Fahrenheit; warm season grasses' optimum growing temperature is 80 to 95 degrees Fahrenheit.

In initiating dryland turf, several points to keep in mind are:
1) establishment is dependent upon soil moisture, therefore, the quality of turf is dependent upon good soil preparation for maximum water infiltration; 2) fertilization the first few years may be of more benefit to the weeds; 3) with some dryland grasses, establishment may take two to three years; 4) the uses of dryland

grasses as a lawn are still in the developmental stage (except for *Zoysia*).

For the next three years, the six plots in this section will be grown under conditions we feel will produce high quality turf. Fertilization will occur as soil tests indicate the need. Two inches of moisture will be applied every three weeks, taking natural precipitation into consideration. A mowing height of 1½ to 2 inches will be maintained throughout the growing season and pesticides will be applied as problems arise.

The grasses selected for this area are:
1) Buffalo/Blue Grama mix
2) Sharp's Improved Buffalograss, *Buchloe dactyloides* 'Sharp's Improved'
3) Manchar and Lincoln Smooth Brome, *Bromus inermis* 'Manchar' and 'Lincoln'
4) Meyer Z-52 Zoysia, *Zoysia japonica* 'Meyer Z-52'
5) Blue Grama, *Bouteloua gracilis* (HBK) Lag.
6) Crested Fairway Wheat, *Agropyron cristatum* 'Fairway Strain'

SECTION II: This area consists of both cool and warm season grasses with low and high water requirements. We will observe how the selected varieties will perform under reduced maintenance levels. One and one-half pounds of nitrogen per 1000 square feet will be applied per year and a mowing height of 1½ to 2 inches will be maintained; clippings will not be removed. Pesticides will be applied only as needed. There will be no irrigation except if dormancy or the loss of a plot is imminent. This section will be compared frequently with Sections I and IV.

The grasses selected for this area are:
1) Lincoln Smooth Brome, *Bromus inermis* 'Lincoln'
2) Fults Alkaligrass, *Puccinellia distans* 'Fults'
3) Alta Tall Fescue, *Festuca arundinacea* 'Alta'
4) Blue Grama, *Bouteloua gracilis* (HBK) Lag.
5) Buffalograss, *Buchloe dactyloides* (Nutt.) Engelm.
6) Fairway Crested Wheat, *Agropyron cristatum* 'Fairway Strain'
7) Barton Western Wheat, *Agropyron smithii* 'Barton'
8) Bermudagrass, *Cynodon* species
9) Merion Kentucky Bluegrass, *Poa pratensis* 'Merion'
10) Citation Perennial Ryegrass, *Lolium perenne* 'Citation'

SECTION III: This area consists of 1) a weed identification display, 2) non-plant ground covers and mulch material and 3) one plot of Merion Kentucky Bluegrass, to demonstrate turf growing on unamended soil. This plot will be checked with the Merion Bluegrass in Sections II and IV.

Selections for this area are:
1) Crushed black/red lava rock
2) Red lava rock
3) Black lava rock
4) White lava rock
5) Gold ore rock
6) Shredded decorative bark
7) Finely shredded bark
8) Medium decorative bark
9) Merion Kentucky Bluegrass on unamended soil
10) The weed display and wood chip mulch
11) Red Breeze crushed limestone

SECTION IV: In this area we planted ten varieties of cool season grasses. They will be maintained to provide high quality turf throughout the growing season.

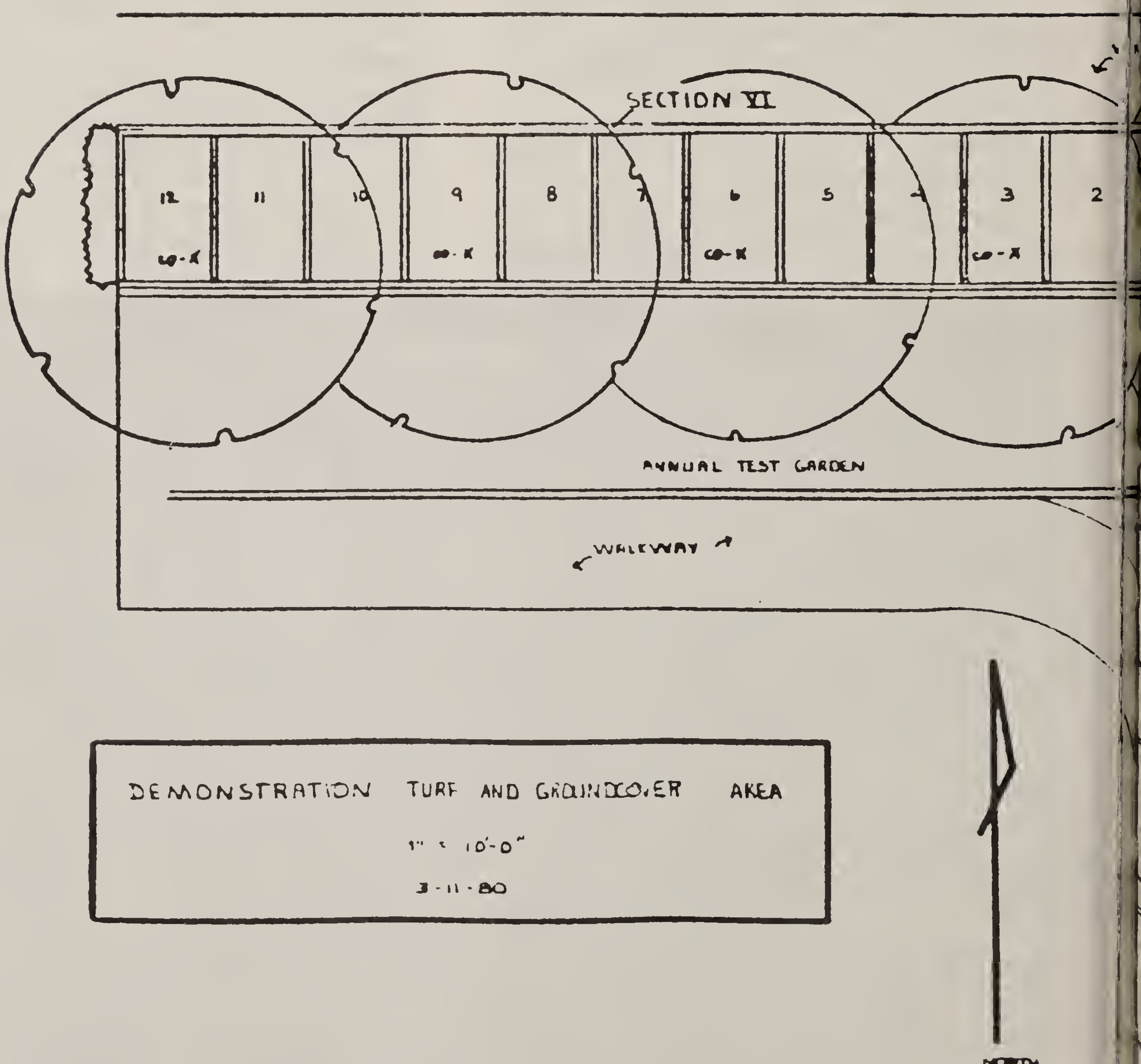
The prescribed routine will allow for four pounds of nitrogen per 1000 square feet per year with 1½ inches of moisture per week, taking into account natural precipitation. We will maintain a mowing height of 1½ to 2 inches and follow a pesticide program that is responsive to the conditions of the turf.

The grass selections are:
1) Biljart Hard Fescue, *Festuca ovina duriuscula* 'Biljart'.
2) Dawsons Spreading Fescue, *Festuca rubra trichophylla rubra* 'Dawson'
3) Rugby Kentucky Bluegrass, *Poa pratensis* 'Rugby'
4) Pennfine Perennial Ryegrass, *Lolium perenne* 'Pennfine'
5) Manhattan Perennial Rye, *Lolium perenne* 'Yorktown'
6) Merion Kentucky Bluegrass, *Poa pratensis* 'Merion'
7) Yorktown Perennial Rye, *Lolium perenne* 'Yorktown', Biljart Hard Fescue. *Festuca ovina duriuscula* 'Biljart', Parade Kentucky Bluegrass, *Poa pratensis* 'Parade'
8) Baron, Ram I, and Adelphi Kentucky Bluegrass, *Poa pratensis* 'Baron', *P. p.* 'Ram I', *P. p.* 'Adelphi'
9) Baron Kentucky Bluegrass, *Poa pratensis* 'Baron'
10) Glade Kentucky Bluegrass, *Poa pratensis* 'Glade'

SECTIONS V and VI: These sections consist of ground covers most suitable for sunny and/or shady exposures. Ground covers are becoming more popular and if used properly, require less care than turfgrass. With the developing philosophy of water and energy conservation, plants other than grasses can be efficient and effective. Many ground covers have attractive flowers, fruits, and fall color as well as foliage. They are not a substitute for grasses as

Ground Covers

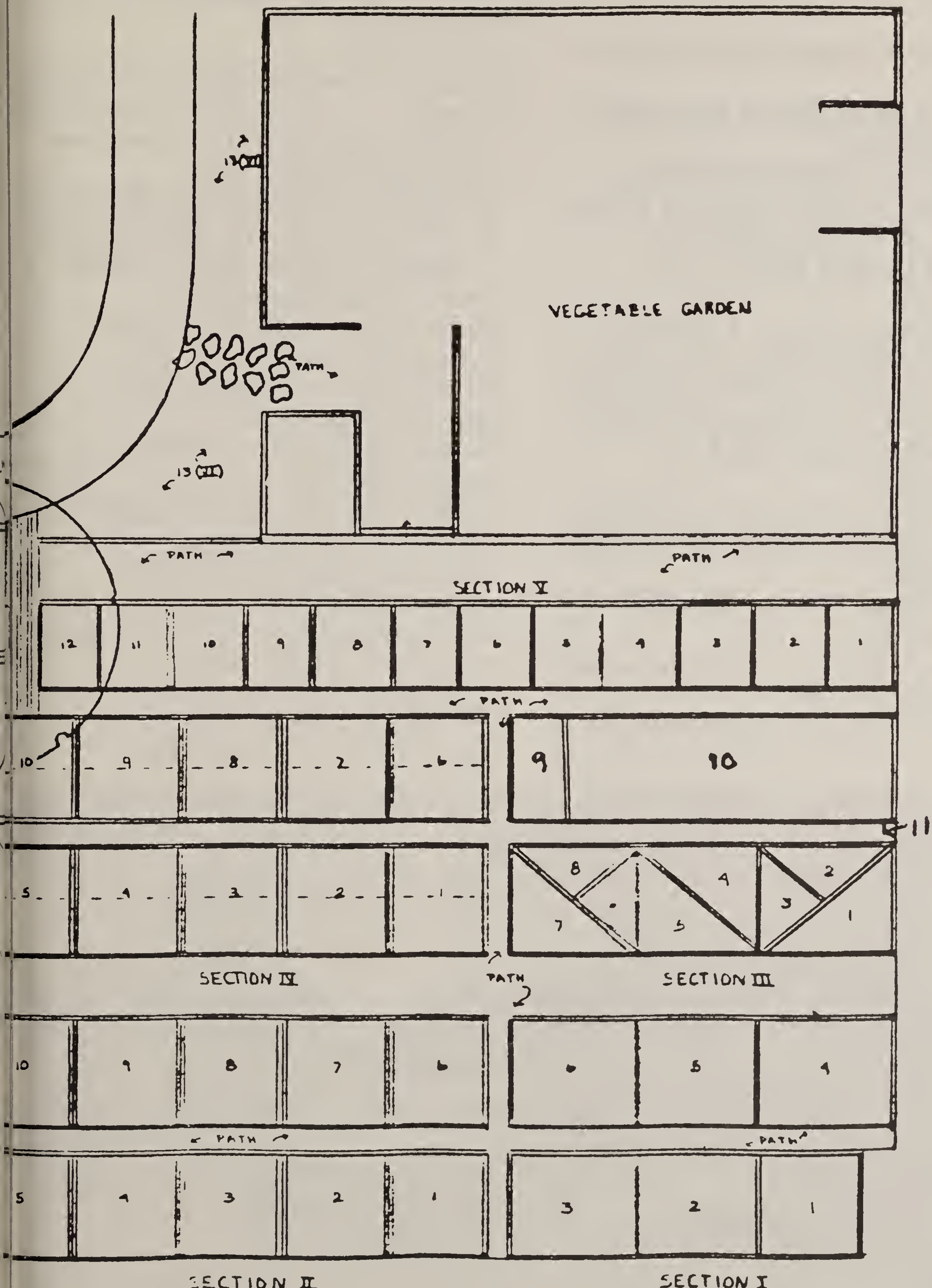
16



DEMONSTRATION TURF AND GROUNDCOVER AREA

1" = 10'-0"

3-11-80


VEGETABLE GARDEN
PATH
SECTION V
SECTION IV
SECTION III
SECTION II
SECTION I

they do not withstand heavy traffic. However, on steep slopes, in heavy shade, in wet or dry areas, and other difficult areas, ground covers may be a suitable solution.

Ground covers for sun in Section V. are:
1) Snow in Summer, *Cerastium tomentosum* L.
2) Woolly Veronica, *Veronica pectinata* L. (This selection will be planted on the grounds and replaced in May with a new selection.)
3) Caucasica Sage, *Artemisia caucasica* Willd. has been planted east of the Lilac Garden and will be replaced with a new selection.)
4) Woolly Yarrow, *Achillea tomentosa* L.
5) Pussytoes, *Antennaria* species
6) Penstemon, *Penstemon caespitosus* Nutt.
7) Creeping Thyme, *Thymus serpyllum* L.
8) Woolly Thyme, *Thymus pseudolanuginosus* Ronn.
9) Carpet Bugle, *Ajuga reptans* L.
10) Border Jewell Polygonum, *Polygonum affine* 'Border Jewell'
11) Spring Cinquefoil, *Potentilla tabernaemontani* Asch.
12) Prostrate Germander, *Teucrium chamaedrys* 'Prostratum'

Ground covers for shade in Section VI are:
1) Blue Leadwort, *Ceratostigma plumbaginoides* Bunge
2) Myrtle, *Vinca minor* 'Bowles'
3) *Veronica* species (observation)
4) Bronze Carpet Bugle, *Ajuga reptans* 'Atropurpurea'
5) St. Johnswort, *Hypericum olympicum* L. (observation)
6) Barrenwort, *Epimedium alpinum* L. *roseum*
7) Kew Euonymus, *Euonymus fortunei* 'Kewensis'
8) Kinnikinnik, *Arctostaphylos uva-ursi* (L.) K. Spreng.
9) Sweet Woodruff, *Galium odoratum* (L.) Scop.
10) Mountain Lover, *Pachistima myrsinites* (Pursh) Raf.
11) English Ivy, *Hedera helix* L.
12) *Mahonia repens* (Lindl.) G. Don, Creeping Oregongrape

Turf Plots

Jojoba, A Potential Arid Region Crop Resource

Deborah A. Samac

In the past decade, the industrialized nations have been forced to recognize that the natural resources on which they depend are limited. Thus, petroleum products are in high demand and short supply. The former alternative for petroleum lubricants was sperm whale oil. However, the sperm whale is an endangered species and sperm whale products are banned in the United States. Synthetic alternatives for the sperm whale oil are available but expensive. There is a natural substitute for sperm whale oil products which recently has been the subject of considerable interest. Jojoba (*Simmondsia chinensis* (Link) Schneider), is a plant native to the American southwest that produces a seed containing a liquid wax almost identical to sperm whale oil. Since 1974, jojoba (pronounced ho-ho-ba) has attracted attention as a possible commercial crop. Extensive international research is now being done to increase knowledge about the plant and bring it to successful plantation cultivation.

Jojoba is an evergreen shrub found naturally in the Sonoran Desert region of Arizona, California, and Mexico. The bushes grow from 0.6 meters in areas of low moisture to 5 meters in more favorable areas. They have deep root systems often measuring 10 meters to tap wet zones on top of water tables. They grow naturally in coarse textured soils of marginal fertility which receive little moisture — from 7.6 to 45 cm of rain a year. The plants tolerate high levels of salt and boron and are often found growing near the ocean's edge. The plants do not seem to need fertilizers and are not yet affected by major disease or insect pests. Jojoba starts producing seeds in three to five years and often lives to an incredible age of 100 to 200 years.

Jojoba is a naturally dioecious plant having both male and female individuals. Flower buds form in late summer or early fall after the previous crop of seeds matures. They remain quiescent until warm, wet spring days when anthesis occurs. The urn-shaped pistillate flowers are quite inconspicuous. Each ovary contains three ovules but only a single seed usually develops. The staminate flowers occur in clusters and are very conspicuous due to the large quantities of pollen produced. Pollination, by wind, occurs in March and the fruit is mature by July or August. The fruits are capsules which turn gradually from green to brown on maturation. Cotyledons make up the bulk of the seed. The cotyledonary cells are filled with liquid wax that flows freely when the large seeds are cut.

Ms. Samac is doing graduate work at Colorado College in Colorado Springs. Her subject is jojoba research.

The seeds contain about 50% liquid wax. This wax can be extracted by standard techniques employed to extract vegetable oils from corn, peanuts, and olives. The chemical structure of jojoba wax is unique from those of vegetable oils. The only other organism that produces a similar liquid wax in any quantity is the sperm whale. That the two developed virtually identical liquid waxes is one of nature's great curiosities.

Jojoba has long been valued by native Americans and it was recognized by early explorers for its unique and valuable properties. The wax was commonly used as a wound salve, for hair oil, and for making candles.

Jojoba has appeared in the botanical literature since 1822. The first specimen described by Link was erroneously believed to have come from China and was named *Buxus chinensis*. In 1844 Nuttall described a speciment from southern California which he named *Simmondsia californica*. It was later realized that they were the same species. Jojoba has recently been classified as the only member of a unique family, the Simmondsiaceae. It was previously included in the Buxaceae or Boxtree family which is a large, cosmopolitan group. Jojoba has many common names including deer-nut, coffeeberry, wild hazel, and hohowi. The preferred common name, jojoba, is probably a Spanish transliteration of the Indian "hohowi."

The liquid wax from jojoba has many commercial uses. It is an excellent base for the manufacture of high grade cosmetics, ointments, and as an anti-foaming agent in the production of penicillin. When hydrogenated it forms a hard, crystalline wax and can be used for high quality candles. It is also suitable for use in polishes, waxing fruit, impregnating paper containers, and manufacturing carbon paper. When sulphurized it is very stable and can be used as a lubricant for machinery operating at high temperatures and pressures. The liquid wax from jojoba is chemically purer than sperm whale oil, is odorless, and does not become rancid. It is indigestible by humans and can be used as a low calorie cooking oil.

At present, all jojoba oil comes from seed of native stands. Harvesting wild stands has provided jobs and strengthened the economy of the southwest Indian tribes. It could be the basis of an Indian owned and operated industry.

It is evident that native stands are an extremely valuable natural resource. These stands are providing seed for research and development. Increasing demand for the wax by industry cannot be met solely from harvesting wild stands. It will require domestication of the species so that a high volume of seed can be produced.

Domesticating a wild species can be a very complex and lengthy process. Successful establishment of plantations depends on developing superior genetic strains of the plant, developing suitable cultural practices, and designing low cost harvesting systems. Most wild jojoba plants yield poorly and often do not produce seeds regularly. Attempts have been made to produce superior plants by vegetative means. However, these plants have been as variable in yield as plants selected from seed. It is still not possible to distinguish male from female seed-

Jojoba Tree

lings before flowering. However, a monoecious strain with perfect flowers has recently been developed which may eliminate this problem. In addition, planting sites must be chosen with care for soil, water, and temperature requirements. Currently, jojoba is harvested by hand which has proven to be expensive and inefficient. Experimental plantations have forced plants into hedgerows and multi-stemmed trees so that mechanical harvesters can be used.

The domestication of jojoba also poses ecological problems. On a long term basis the effects of pruning and seed hull removal by pickers could influence soil structure and fertility. The impact of seed harvesting on natural propagation could be significant. Seed removal could limit the food resources of animals and insects in the area, reducing their population and populations of animals higher in the food chain.

The economic value of jojoba will depend not only on the liquid wax but also on the utilization of the meal, the residue remaining after removal of the oil from the seed. In other oil seed industries this meal is used as a food supplement

for livestock. Jojoba meal is high in protein, about 30% by weight. It will be a good protein source if certain nutritional problems can be resolved. The primary problems involve the removal of a toxic cyanide compound and a digestive enzyme inhibiting compounds.

The research that I have been involved in has dealt with the biochemical nitrogen or protein metabolism of jojoba. The majority of basic research with jojoba has dealt with morphology of the plant or lipid (liquid wax) metabolism of the seed. Our initial investigation concerned the characterization of reserve proteins in the seed and monitoring protein degrading proteases during seed germination. Mature jojoba seeds store proteins and lipids in membrane bound vesicles within the cotyledonary cells which serve as a food reserve during germination. If the meal is to be used as a food supplement it is important to determine its nutritional quality. It may also be possible to select for plants that produce a more nutritionally complete protein. Almost nothing is known about mechanisms which regulate protein breakdown and protein turnover in plants during germination. Even less is known about these processes in oil seeds, especially from plants growing in their natural habitat. These studies may provide information to jojoba breeders while increasing the basic knowledge about mechanisms governing growth and development in arid land plants.

Jojoba proteins were characterized on the basis of solubility into basic protein groups. Seeds from several natural stands in the United States and Mexico were examined. There was little variation in protein content of the seeds from various sources. However, there was considerable variation in the relative amounts of the different protein groups from different sources. The seeds have a relatively high albumin fraction (containing the essential amino acid, lysine) suggesting that the meal may provide a better complement of essential amino acids than other traditional plant protein sources. If oil content is not affected, it might be worthwhile to use seeds high in albumin for cultivation.

The proteases active in germination were examined during a 30 day developmental study. Germinating seeds were tested for exopeptidases (enzymes breaking down the ends of an amino acid chain) and endopeptidases (enzymes breaking down the middle of an amino acid chain). From these studies we have characterized five to eight separate enzymes active at different pH optima and at different points in germination. These enzymes work in concert and are responsible for the reserve seed protein breakdown.

We have also found a protein in the seed that inhibits the action of the digestive enzyme trypsin. In the seed, this inhibitor may act as a natural pesticide protecting the seed against insect or animal attack. We found that the inhibitor is inactivated by high temperatures so that the presence of the inhibitor may not be a major obstacle in the commercial use of the meal.

Jojoba, like many other plants, is becoming the subject of a fad popularism. Jojoba soaps and shampoos are for sale in local supermarkets, and jojoba oil is

Jojoba Fruit

proclaimed by some advertisers as a cure for many physical ailments. In addition, there are individuals with little farming experience or capital who are planting jojoba under the impression that it is a "miracle" plant that will produce a good profit with little effort. Jojoba is not such a miracle plant. It does have great agricultural promise since it grows naturally and fruitfully in dry, hot, infertile areas not being used for other crops. It has great economic potential not in the fad shampoo products but as a valuable replacement for sperm whale oil in industry. The promise of jojoba lies in this more serious area.

Jojoba is now being recognized around the world as a potential new resource. It is being grown and researched seriously in arid regions in the United States, Mexico, Israel, Australia, Africa, and India. Within this decade jojoba oil may become an integral part of world agriculture and industry.

References

1. Dunstone, R. L. and J. E. Begge, 1979. *Domesticating Jojoba.* Australian Natural History 19: 328-335.

2. Foster, Kenneth E., 1980. *Environmental Consequences of an Industry Based on Harvesting the Wild Desert Shrub Jojoba.* BioScience 30: 255-258.

3. Hogan, LeMoyne, 1979. *New Agricultural Crops.* Westview Press, Boulder.

4. Hogan, LeMoyne et al, 1980. *Jojoba: A New Horticultural Crop for Arid Regions.* HortScience 15: 114.

5. Johnson, Jack D. and Hinman C. Wiley, 1980. *Oils and Rubber from Arid Land Plants.* Science 208: 460-464.

6. Moreau, Robert A. and Anthony Huang, 1977. *Gluconeogensis from Storage Wax in the Cotyledons of Jojoba Seedlings.* Plant Physiol. 60: 329-333.

7. Samac, D., C. Lovejoy and R. Storey, 1980. *Protein Content, Trypsin Inhibitor and Nitrogen Metabolism in Jojoba Seeds.* Jojoba Happenings (in press).

8. Verbiscar, Anthony J. et al, 1978. *Detoxification and Analysis of Jojoba Meal.* Proceedings Third International Conference on Jojoba.

9. Vietmeyer, Noel, 1979. *Thar She Grows!* Quest, May: 64-66.

10. Yermanos, D. M. and R. Gonzales, 1976. *Mechanical Harvesting of Jojoba.* California Agriculture, January.

11. Yermanos, D. M., 1979. *Jojoba—A Crop Whose Time Has Come.* California Agriculture July-August: 4-10.

12. Yermanos, D.M., 1980. *Jojoba Changes Life Style.* Jojoba Happenings 32: 1-2.

Mass Plantings of Wildflowers

Dee and Gene Milstein

During the past several years our Associates and we have carried out a series of tests on mass plantings of wildflowers in the foothills and mountains west of Denver up to 8,500 ft. elevation. There are several significant differences which must be noted when seeding in the mountains. Temperatures are lower and the season is shorter; therefore, more attention must be given to moisture, soil, light, and wind in order to achieve maximum success.

In the foothills and mountains, soils may vary widely from sandy or rocky to rich acid loam. The highly alkaline conditions found at lower elevations are seldom present. Most wildflowers do not require a rich soil; the ability of the soil to retain an optimum amount of moisture is a far more important factor. Northern slopes, shady areas, and those near streams are moisture-retentive but may be deficient in sunlight, resulting in slow growth and late flowering of some species. Wind, particularly in open meadows and unforested canyons, will dry out the soil quickly and lower temperatures.

As a result of trials in a variety of the above conditions, two general conclusions became apparent: 1) availability of moisture is the single most important factor affecting growth, and 2) soil condition is a critical factor in controlling moisture availability.

Wildflower Mix for Moist Areas

Gene and Dee Milstein founded Applewood Seed Co., a Lakewood firm specializing in seeds of wildflowers and culinary herbs. They have been testing wildflowers in the Denver and adjacent mountain areas for many years.

In very sandy or rocky soils, high germination was achieved if consistent moisture was available. When watering was discontinued or rains ceased, growth slowed markedly, and some plants did not survive.

To determine whether adequate moisture is available in a given area, note the existing vegetation. If it remains green throughout the summer, there is probably adequate moisture for wildflowers; if vegetation is brown in July and August, help is needed. There are several ways to improve water-retentiveness. If the ground is hard-packed, it should be tilled to a depth of 6-8 inches. Then add peat moss, compost, leaf mold, or sawdust; these materials should be well decomposed or they will deplete the soil of nitrogen. Another option is to add a 6-12 inch layer of new topsoil; this may be the best solution on new construction sites.

On steep slopes or in windy locations where it is not practical to improve the soil, a top covering of any of the following materials will help considerably to retain moisture: fir bark, wood chips, gravel or lava rock (1-2 inch size in all cases). Use just enough material to cover the soil from view. Sow the wildflower seeds directly into the top covering so they fall into the cracks and crevices. In this way, the seeds will be protected but not covered, and young seedlings will be sheltered from the wind.

If native grasses or other ground covers are already present, they will win the competition for water, and wildflowers will be hard to establish. Trials indicate that it is preferable to till five or six sites per acre (about 250-1,000 square

Wildflower Mix — Annuals for Sun

feet per site) and to plant these exclusively with wildflowers. The flowers will spread on their own once they are well established.

Spring is the ideal time to plant wildflowers because supplemental waterings can be kept to a minimum. For best results, keep the ground consistently moist for 4-6 weeks after planting. If moisture can be maintained and temperatures are cool, mid-summer seedings are also successful. Fall plantings are fairly risky because seed may be blown or washed away or eaten by birds or insects.

Many sun-loving wildflowers will adapt to partial shade but growth will be slower. (Columbine, the Colorado state flower, will grow equally well in sun or shade, provided it receives ample moisture.) Fertilizing lightly once or twice a year (spring, midsummer) will improve growth and flowering, but is necessary only if the soil is very poor.

In summary, the trials we have carried out over the past several years indicate that large areas of wildflowers can be established successfully in mountain areas.

Colorado Natural Heritage Inventory

J. Scott Peterson

The State of Colorado contains much natural diversity, due in part to the interaction of climate and topography, giving us the high desert of the Four Corners region and the alpine tundra of the Rockies. The forests, wetlands, prairies, tundra, streams, endemic plant and animal taxa, and unique geologic formations of Colorado comprise part of this natural diversity. These can be considered also as elements of our natural heritage.

As agricultural, urban, recreational, and energy/industrial development continue, we are confronted with the possibility of a reduction of our complete complement of natural diversity in Colorado. The decision-makers guiding the development of Colorado and the members of the public influencing them are in need of accurate information regarding our natural diversity to assist in making ecologically sound decisions. Recognizing this factor, numerous persons from state and federal agencies, private industry, and The Nature Conservancy concluded that we must preserve the most outstanding representatives of the State's natural heritage for the well-being of present and future generations.

Fortunately, there are still many relatively unspoiled natural areas that represent a wealth of natural diversity. These areas are the refuges of rare and endangered plant and animal species, as well as havens for the urbanite who seeks serenity and renewal in the outdoors. These resources must be carefully conserved, for there is a basic interdependence of species which extends from mankind to the most inconspicuous organism.

Before the diversity of Colorado can be conserved, one must first know what exists. Toward this goal, the Colorado Natural Heritage Inventory (CNHI) was formed. After negotiations between the Colorado Department of Natural Resources and The Nature Conservancy (TNC), a contract for two years of funding from TNC was signed and an office was established in Denver in 1979. Financial support for the CNHI is obtained from private foundations, federal and state funding, and industry.

The CNHI is gathering data pertaining to four phases of the natural diversity in Colorado:

J. Scott Peterson is the botanist for the Colorado Natural Heritage Inventory, a director of the Colorado Native Plant Society, and pursuing a Ph.D. in botany at CSU.

Astragalus lutosus

Special Plants, Plant Communities, Special Animals, and Geologic Features. The in-house specialists include a biologist, zoologist, geologist, and a systematic plant ecologist. The inventory methodology that the CNHI utilizes was developed by The Nature Conservancy, and is used by TNC Heritage Programs initiated in cooperation with over twenty other states.

The Nature Conservancy has been cooperating with states in setting up these inventories to assist in the continuous collection of biological data. Besides providing the State with comprehensive data on its elements of natural diversity, the inventory also provides TNC, the Colorado Natural Areas Program, and other land management agencies and organizations in the State with information on areas high in natural diversity and most vulnerable to destruction.

The basic units in the Natural Heritage Program are the elements of diversity. These elements are defined as a natural feature of particular interest either because it is unique, exemplary, or endangered state or nationwide. Examples of elements include the spineless hedgehog cactus, the peregrine falcon, a unique cave, and an old bristlecone pine community. A major shortcoming of past inventories has been the limitations imposed by arbitrary site specific methodology. This may and does result in the collection of data on elements that occur

widely, while the few remaining examples of very rare or endangered elements may be passed over. With an element-based inventory, the search for information is directed toward occurrences of a specifically defined element, so that data on even the most rare element are obtained. This allows for the input of new data and for providing decision-makers with a more complete picture of the Colorado landscape.

The portion of the CNHI program devoted to Colorado plants is divided into two parts: information on Individual Species of Special Concern and Plant Communities. The first step in the development of the plant aspect of the program is the compilation of a species list of Special Concern plants, and the generation of a classification/filing scheme for the Plant Communities.

Regarding the individual species, the CNHI has compiled a list for which it is gathering distributional and ecological information. This list is dynamic and is revised periodically as new information is acquired from the lay and professional botanists in the State. Species on this list are considered by the CNHI to be of special concern statewide for numerous reasons. When considering a taxon for inclusion on this list, the primary point is to limit the study to the political borders of the State. This reiterates the fact that the Inventory is expressly concerned with the natural diversity of Colorado, and geared to gathering information that will assist in retaining that diversity. The specific reasons for including a species may be attributed to the following: a federal threatened or endangered species, a widely disjunct species, an endemic species, a species rare in Colorado, a species vulnerable to destruction, or a species for which we have little knowledge for decision-makers. Most of these species would qualify for Sensitive Species designation under U.S. Forest Service and Bureau of Land Management policies.

The Plant Community classification/filing scheme is developed so that a specific community type (and its accompanying occurrence and biological information) can be easily stored and retrieved. This scheme is hierarchical in nature to allow for the input of increasingly specific information, which permits the temporary categorization of even the most poorly studied stands. As more data are accumulated on a certain stand, it is moved further up the hierarchy to reflect that knowledge.

The first effort on gathering information regarding the Special Plants and Plant Communities of Colorado is directed toward secondary sources: scientific literature, herbaria, unpublished materials, and knowledgeable individuals. Direct field inventories, though important, will not be of prime importance until the backlog of secondary sources is assimilated. During the 1980 field season, the CNHI cooperated with the Colorado Natural Areas Program in contracting to Dr. William Harmon, in association with the Colorado Native Plant Society, for field inventories on twenty-five Plant Species of Special Concern. The CNHI is currently preparing Status Reports on these species for submission to the

Penstemon grahamii

funding agency, the U.S. Fish and Wildlife Service.

The gathering of data and the updating of our files is an endless process that will need to be continued for as long as our landscape changes. The Inventory is working hard to put as much information as possible into the manual and computer files prior to the end of its two year contract, and prior to the assimilation of the CNHI into the State government. Because of the present emphasis on data gathering, and the unfinished nature of the data bank, requests for information will not be honored until later this year.

Readers are encouraged to contribute to the Inventory if they have knowledge of the Plant Communities and Special Plants of Colorado. If you would like to be of assistance, please call me at (303) 623-1913 or CNHI, 1726 Champa Street, Suite 307, Denver, Colorado 80202.

References

Fisher, M. N., & S. C. Buttrick 1980. "Massachusetts natural heritage program." *Rhodora* 82:227-237.

Ohio Natural Heritage Program 1977. Ohio natural heritage program technical report. Ohio Department of Natural Resources and The Nature Conservancy. pp. 193.

Focus On
Ananas comosus
in the
Boettcher Memorial Conservatory

Peg Hayward

Ananas comosus (L.) Merr., pineapple, belongs to the monocotyledonous family Bromeliaceae which is comprised of about 60 genera and 1500 species. These herbaceous plants are confined to the tropics and subtropics of the New World with the exception of a single species.

Pineapple was apparently first domesticated by the Guarani Indians of what is now northern Paraguay. The species spread throughout lowland South America east of the Andes, and was taken to the Caribbean area by the Caribs. The first European of note to set eyes on a pineapple was Christopher Columbus in 1493 when visiting the island of Guadalupe. He received the fruit in barter with the Indians. After the arrival of the Europeans, pineapple cultivation spread rapidly. Fruits taken to Europe were highly esteemed and gardeners of northern Europe were attempting to produce them under glass. In 1605 the Portuguese were planting it in India.

Mrs. Peg Hayward's long association with the Boettcher Conservatory enables her to write about the exotic plants housed there. "Focus On" has been a regular feature of The Green Thumb for several years.

The European name, *anana,* derives from the Guarani Indian language, in which *a* signified fruit in general and *nana* meant excelling. The vernacular name is from the Spanish *pina* which was given to the fruit because it looks somewhat like a pine cone. The English called it pineapple, although it bears no resemblance to the apple.

The pineapple, a terrestrial bromeliad, grows in a rosette form with several tiers of tough, slender, sharp-pointed leaves which curve outward and downward from the central stalk. The leaves are usually barb edged and about 3 feet long. After 12 to 24 months the main axis produces from its terminal bud a peduncle bearing a cone-like inflorescence of sessile red-purple flowers arranged spirally and each subtended by a bract. The pineapple itself is a multiple fruit from the partial fusion of 100 to 200 berrylike fruitlets, in which the hardened sepals and bracts coalesce into a rind over the outside. The fruit is topped by a crown of tiered leaves. New plants are grown from the crown, from slips which develop at the base of the fruit, or from suckers or "ratoons" at the base of the plant.

Ananas comosus

Pineapples are best harvested fully ripe in order that the full flavor may be developed. A large quantity of starch is stored in the plant stem. Just before ripening, this starch turns to sugar and is carried into the fruit. The sugar content sometimes increases 100 percent in this last stage.

About four-fifths of the pineapples entering world trade come from the Hawaiian Islands where the best pineapples are grown. The annual shipments from Hawaii to the continental United States exceed 200,000 tons of fresh and canned fruit and nearly as much prepared as canned or frozen juice.

The leaves yield a strong white silky fiber used for making a fine fabric called pina cloth in the Philippines and Taiwan; it is also used for cordage. For fiber production special cultivated varieties are grown at close spacing and the young fruits are removed soon after flowering so that the leaves may develop more fully.

Most members of the Bromeliaceae family are ornamental plants and like the orchids many tropical members of the family are epiphytes found on horizontal tree limbs in the rain forests of tropical America. The Boettcher Memorial Conservatory is fortunate in having an outstanding Bromeliad collection.

References

Bailey, L. H., 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

Brouk, B., 1975. *Plants Consumed by Man.* New York: Academic Press.

Milne, Lorus and Margery, 1967. *Living Plants of the World.* New York: Random House.

Purseglove, J. W., 1972. *Tropical Crops Monocotyledons I.* New York: John Wiley & Sons, Inc.

An Unusual Flowering

Andrew Pierce

A "blessed event" of note in the Conservatory in the autumn of 1980 was the flowering of *Brighamia citrina* (Forbes & Lydgate) St. John var. *nepaliensis* St. John. Among our many plants we have a few that are considered endangered species in their native habitat. *B. citrina* is one of them, so we were very delighted to have it bloom for us. The genus is from Kauai in the islands of Hawaii.

Our plant which came to us from Longwood Gardens has an unsplit creamy pastel tubular flower approximately 13 centimeters in length and 6 centimeters across. The flowers are borne just beneath the shiny green leaves (up to 20 centimeters long) which are clustered at the top of the succulent stem. It is an unusual member of the Lobeliaceae in that it is not only tree-like but has a completely unsplit tube. Not the least of its attractions is the delightful scent, which is rather like that of frangipani.

In its native habitat *B. citrina* grows on north facing cliffs and can reach 2 meters or more in height. The roots are modified to penetrate the cliff face and to allow the plant to sway in the wind.

Most authorities list only the type plant, *Brighamia insignis* Gray, which has white flowers, but mention of our species can be found in St. John's list below. St. John named additional species of *Brighamia* in 1959, when he was associated with the University of Hawaii.

Brighamia citrinia

Andrew Pierce is the superintendent of the Conservatory-Greenhouse complex at Denver Botanic Gardens.

References

Carlquist, Sherwin J., 1980. *Hawaii a Natural History*, Lawai, Hawaii, Pacific Tropical Botanical Garden.

Neal, Marie C. 1968, *In Gardens of Hawaii*, Honolulu, Bishop Museum Press.

St. John, Harold, 1973. *List and Summary of the Flowering Plants of the Hawaiian Islands*, Lawai, Hawaii, Pacific Tropical Botanical Garden.

Denver Botanic Gardens, Inc.
A Non-Profit Organization

Officers

Mr. Richard A. Kirk	President
Mr. Edward P. Connors	Vice-President
Mr. Newell Grant	Vice-President
Moras L. Shubert, Ph.D.	Secretary
Mr. William J. Lunsford	Treasurer

Staff

Mr. Merle M. Moore	Director
Mr. Andrew Pierce	Conservatory Superintendent
Mr. Larry Latta	Botanist-Horticulturist
Ms. Beverly M. Nilsen	Botanist-Horticulturist
Ms. Gayle Weinstein	Botanist-Horticulturist
Mr. Panayoti Peter Callas	Curator, Rock/Alpine Garden
Mr. Kay Kawahara	Specialist, Japanese Garden
Miss Margaret Sikes	Education Director
Ms. Solange Gignac	Librarian
D. H. Mitchel, M.D.	Honorary Curator of Mycology
Mrs. J. V. Petersen	Honorary Editor of *The Green Thumb*
Helen Marsh Zeiner, Ph.D.	Honorary Curator of the Kathryn Kalmbach Herbarium
Mrs. Gloria Falkenberg	Honorary Director of Development
William G. Gambill, Jr. Ph.D.	Director Emeritus

Illustration Sources

Outside front cover, Pgs. 7, 9, 12, 32 photos by William H. Anderson, Jr.
Pgs. 3, 4, 5 Photos, *Green Thumb* file
Pgs. 15, 18 Photos by Robert Dodge
Pgs. 16-17 Drawing by Gayle Weinstein
Pgs. 21, 23 Photos by Jane Lopez
Pgs. 24, 25 Drawings by Dee and Gene Milstein
Pgs. 27, 29 Photos by J. Scott Peterson
Pg. 31 Drawing by Phil Hayward

The Green Thumb

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Do Not Fold

Address Correction
Requested

The Green Thumb

Summer 1981 Vol. Thirty-eight

Number Two

The Cover
Rock Garden

The Green Thumb
Summer 1981
Vol. Thirty-eight, Number Two

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student \$10.00, Individual Senior Citizen \$10.00, Individual \$15.00, Family \$25.00, Contributing \$50.00, Supporting \$100.00, Corporate \$200.00, Patron \$500.00, Benefactor \$1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2547.

The Green Thumb

Summer 1981

Jane Elkind Bowers
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Andrew Pierce Selected for Assistant Directorship

Merle M. Moore

Those readers whose perusal of *The Green Thumb* is, literally, cover-to-cover will note a significant change in the staff listing on the inside-back cover of this issue: the name of former conservatory superintendent Andrew Pierce aligned next to his new title, assistant director of the Denver Botanic Gardens.

It was my pleasure to conclude our seven-month-long selection process by offering the assistant directorship to Mr. Pierce at the end of April. His acceptance of the position, effective May 1, was and is cause for all who are associated with the gardens to view the future with renewed faith in our ability to attract and retain the kind of staff that makes it possible for us to maintain a level of operation in which we can all take pride.

Since becoming superintendent of the Boettcher Memorial Conservatory five years ago, Mr. Pierce has forged close and effective working relationships with the volunteer organizations so vital to operation of the gardens, as well as with many individual members and volunteers and his staff colleagues. There is no question in my mind but that those relationships ensure him the kind of encouragement and support necessary to success in his new position.

Mr. Pierce came to Denver with a background impressive in its balanced combination of formal education, practical training, and professional experience in nursery work, indoor plant decoration, and landscaping. In addition to earning a national diploma from the Royal Horticultural Society and certificates from the Kent Horticultural Institute and the Royal Botanic Gardens, Kew, he had worked for several years with the parks departments of Canterbury and Liverpool and for 13½ years as horticultural officer of Bermuda's department of agriculture and fisheries.

The prizes he won while a student at Kew — the Hooker Prize for

---

Merle M. Moore, who was named director of the Denver Botanic Gardens in November of last year, served as assistant director for two years prior to that.

"the most work done by a member" for the Mutual Society and the Grower's Prize as the "most practical gardener" — forecast his later interests and activities in Denver. His years here have been used to develop insight into, and understanding of, native plant materials and local growing conditions, and when development of our Rock Alpine Garden began in 1978, it was Mr. Pierce, working with chief propagator Richard Schimming, who selected for propagation hundreds of plants seldom grown before in this area, to be tested for suitability in Colorado's unusual growing conditions — for use, first, in our own Rock Alpine Garden and for use, eventually, in local gardens throughout the area.

Although our conservatory and greenhouses were brought, undeniably, to new peaks of efficiency during Mr. Pierce's tenure as conservatory superintendent, it has been his enthusiastic and cooperative participation in projects and activities above and beyond the scope of that position for which he has been most appreciated: His coordination of our participation in the Index Seminum international seed-exchange program and his involvement (with many volunteers) in planning and developing the perennial garden along Linden Allé are two examples that come most readily to mind.

I know all members of the Denver Botanic Gardens join me in congratulating Mr. Pierce on his appointment as assistant director.

Andrew Pierce, new assistant director of the Denver Botanic Gardens

A History of Old Garden Roses

William A. Campbell III, M.D.

"New" roses have been introduced for years, generations, and centuries. Growers in all countries of the northern hemisphere admired and developed their own roses, and the history of those roses extends back to the original rose "building blocks," the species roses. Some 300 of those species roses, occupying a geographic range of sub-tropic to arctic, contain the gene pool for today's spectrum of color, size, and foliage characteristics.

Ancient gardeners selected variations from the wild and hybridized between species to begin the countless variations possible today, and by the 17th Century the garden roses of Europe — spring-blooming bush roses that ranged in color from white through rose and scarlet to the deeper purple — fell into several relatively distinct classes: Alba, Damask, Gallica, Centifolia, and Moss (their common names). The Oriental-Asiatic garden roses of that era, the Chinas and the Teas, were similarly distinct. Carried home by European plant explorers and crossed with European roses (which had smaller leaves of a lighter color than their Oriental counterparts), the Chinas and the Teas contributed repeat blooming, large leathery foliage, climbing ability, and the color yellow to the resulting hybrid groups. And those hybrid groups — the Bourbons, Noisettes, Teas, Hybrid Perpetuals, and early Hybrid Teas (plus other species hybrids) — constitute what we know today as the "Old Garden Roses."

Although European roses originated through selection and crossing from (probably) only six species, the resultant five types (*nearly* recognizable as species) had hundreds and hundreds of varieties. Ascertaining the parentage of a given rose was therefore a long and complicated process involving scholarly examination of poetic descriptions and of artists' portrayals in frescoes, paintings, and illustrated manuscripts; investigation of the particular rose's chromosomal constitution; and attempts to repeat the breeding.

With a plant habit best described as short, stiff, and rough, the Gallicas have been favored for their bloom color — vivid reds and deep crimsons and purples — and patterns. Known (because of their dots, stripes, and marbling, plus an easy tendency to sport to new patterns) as "the mad Gallicas,"

One of this area's most widely respected rose specialists, William A. Campbell III, M.D., a pediatric urologist, is a member of the Denver Botanic Gardens' board of trustees.

they do well on their own roots and are noted for suckering in a restrained fashion to fill up their corner of the garden. When the petals of Officinalis, an *R. gallica* of ancient origin, were found to retain their spicy fragrance, that bright-red type became known as the Apothecary's Rose: an essential ingredient of the curative ointments of the Middle Ages. Under that and numerous other names (including the Red Rose of Lancaster), Officinalis has enjoyed enduring popularity, as has its striped sport, Versicolor (*Rosa mundi*).

A nice selection of the Gallicas seen in Colorado includes Alain Blanchard which, like Officinalis, has only 5-11 petals; the best of

the mottled or spotted varieties, it looks for all the world like its maroon and purple petals have been covered with evenly distributed rain spots of paler crimson. Another *R. gallica*, Belle de Crécy, advances with its many fragrant petals from a pink bud to softest-violet into lavender-gray, while Charles de Mills has a ball-like bloom of crimson-purple, lilac, and wine shades. And Président de Sèze shows a persisting and well defined demarcation line between its magenta-crimson central petals
and the lilac-white petals of its circumference.

The Damasks are likely derivatives of the Gallicas but were separate from them by the time of the early Greeks. An important early rose of this type was the Autumn Damask: the only source in those days of late bloom, it extended the selling season of Roman florists, and its fragrance — an intensely sweet old attar-of-rose scent — caused the ancients to value it for medicinal and cosmetic uses. Damasks are more erect than the Gallicas, but their long canes droop becomingly; they sport real thorns, and their foliage is downy-gray on both sides.

Although the species roses *Rosa damascena* and *Rosa damascena bifera* (Autumn Damask) are not seen in the gardens and rose shows of Colorado, *R. damascena trigintipetala* (grown in Bulgaria) can be used for attar of roses, as can *R. damascena versicolor,* the famous York and Lancaster rose of alternating pink-and-white petals. Several other decorative cultivars are also popular, including Madame Hardy, a perfect rose of the period which features numerous petals of purest-white in a flat quartered pattern formed around a small green central eye. Marie Louise, developed in about

1812 at the famous Malmaison Garden (where Empress Josephine collected the world's known roses and commissioned Redouté to document her treasures in paint), has a large bloom that arches the plant's canes with its cool lilac-pink and fragrant petalage. The iridescent milky-white Leda's bloom, aptly known as the Painted Damask, features carmine-tipped outer petals, while the very hardy Banshee — which grows in traffic-stopping masses of pink throughout the older parts of Denver, on farmsteads east of the city, and in the mid-Atlantic states and eastern Canada — is a hybrid noted for its classic Damask fragrance.

Alba roses — the White Rose of England — grow as classic uprights, developing heavy wood below a thicket of twigs that are the flowering laterals so heavy with bloom during the month of June. Great Double White is an English type not grown here, and Konegin von Danemark, a hybrid Alba noted for heavily quartered blooms of a beautifully-even rose color, is often tried but seems short-lived in Colorado's intense sunshine. But Maidens Blush gives us a good example of *R. alba's* bluish-green foliage (which nicely complements hedge borders), the blush-pink of its blossoms fading to a soft-white. Celestial (Céleste) is a reliable rose-colored Alba with fewer petals; its concomitantly slender bud unfurls around prominent golden stamens. And Félicité Parmentier, a small spreading bush of less than five feet, shows us a load of faintest-pink blooms, that are even lighter at their margins and that reflex outward as attractive balls.

Centifolia roses appeared late in the saga of European rose development, evolving primarily through the 17th-Century efforts of Dutch nurserymen. Although the bush they developed is so gangling it can scarcely support itself, and although its leaves are coarse, the flower — which reflected the opulence of the era — so appealed to artists of the day that *R. centifolia* became known as the "Rose des Peintres." With numerous petals so closely curved around one another that the flower remains globe-shaped with a deep open center, *R. centifolia* blooms are clear-pink in color and deliciously intense in fragrance. Since the type was developed through more complex hybridization than its predecessors, it was early prone to sports and mutants, two of which are the only representatives here in Colorado: *R. centifolia bullata,* which has the bush and bloom of the type, features attractively-crinkled foliage with mahogany highlights; and Cristata (Chapeau de Napoleon), which has calyx "wings" so enlarged and crested that its pink buds, which open to a flatter quarter bloom of warm-pink, look compressed from two sides. Although Cristata has been called Crested Moss, its prominent calyceal structure is different from the hybrid group, described below, known as Moss roses.

R. centifolia's tendency to mutate led directly to development of the Moss roses, the opening buds of which feature a conspicuous moss-like encrustation of balsamic scent glands on the sepals, calyx, and flower stem. Sticky to the touch, the glands add a conifer scent to the Mosses' floral fragrance. On sports closest to the Centifolias, the moss is green and soft, but on sports similar to Damask progenitors of Centifolia, it is darker-green to brown and quite prickly. The recurrent-blooming characteristic of Moss roses is

another of their Damask inheritances, though it should be noted that their development, in the early 18th Century, was contemporaneous with the sweeping introduction in Europe of repeat-blooming roses from the Orient, and crosses of the two exciting new types were inevitable. Hybridizers to this day are entranced by the novel texture and scent of Moss roses, bringing old Moss lines into their breeding programs in order to produce Modern Shrub Mosses, Hybrid Tea Mosses, and even miniatures.

R. centifolia muscosa (Common Moss), a direct derivative of the clear-pink Centifolia and a sure

Moss Rose

show winner, features clusters of moss buds opening through the globular form to old-rose-fragrance blooms with quartered petals and button centers; since the white form appeared as a sport in several different locations, it is known by several different names. Comtesse de Murinais, a rose distinguished by its hard Damask Moss touch, has blush-white buds that open into flat quartered blooms of milk-white, but another Moss, Deuil de Paul Fontaine, is one of our darkest roses: with blooms of dark Tyrian rose through purple and maroon to almost black, its chocolate-brown stems emphasize its unusual coloration. Gloire des Mousseux, given a husky appearance by stems that are long and unbending, has prominent leaves and stoutly mossed upright buds that open to pink-and-white blooms of great delicacy, while Jeanne de Montfort, which uses its long canes as climbers or pillars, features large clusters of smaller flowers. Salet, a more modern variety introduced in 1854, gives deep-pink cupped blooms with reliable repeating.

Since one revered authority described the China roses introduced in Europe as "the species that destroyed the floral perfection of the old roses," some old-rose enthusiasts might wish to stop at this point in rose-development time. But enthusiasts in the warmer parts of this country think the fun is just beginning: new arrivals from subtropical China, after all, are what made possible many of the most beautiful (from our modern viewpoint) roses of today. (But credit where credit is due: Even the most enthusiastic of warm-climate enthusiasts admit the importance, in the development of those roses, of genes from the big-shrub, heavy-petalled, and strong-colored European roses.)

Perhaps the richest wild-rose area in the world, China is "home" to more than 100 wild species. Many of those species are themselves useful garden roses, while others have been hybridized to develop new ramblers, climbers, and

miniatures. And the four China-Teas whose introduction to Europe revolutionized the old roses of that continent originated in south-western China, a sub-tropical area where an ever-blooming habit led to successful ripening of seed throughout the long season. Red China, Pink China, Pink Tea, and Yellow Tea are all intergrades between an unknown Red China precursor crossed with *Rosa gigantea*.

40 Although herbarium specimens had been recorded earlier, it wasn't until 1792 that one Red China, *R. chinensis semperflorens*, was introduced into English gardens. Its complete reblooming (in the modern sense) characteristic elicited enormous interest among growers, and the white streaking of its crimson flowers (smallish semi-doubles) is reflected to this day in many red Hybrid Teas.

Pink China, a large greenwood plant depicted in Chinese paintings of a thousand years ago, usually goes by the famous name of Old Blush. Planted next to Autumn Damask on L'Ile Bourbon, it was a hedge of Old Blush that led to development of the ever-blooming and full-blossomed Bourbon roses that are in the direct genetic line of modern roses.

The Pink Tea, introduced in England in 1809 as Hume's Blush Tea Scented China, is identified in a Redouté picture as *Rosa indica fragrans*. The Yellow Tea (*Rosa odorata ochroleuca*), a pale-saffron color flower, contributed less of the yellow Asiatic color than later hybridization with *R. foetida*.

But using the word "hybridization" to describe horticultural activity of that time is misleading. Although the sexual parts and processes of plants were scientifically delineated in the late 1600s, the time was not ripe for suggestions that man could bring into existence new plants not found among those created divinely. The first deliberate cross between two plant species was achieved by Kölreuter in 1761, but it was another hundred years before rose nurserymen adapted his technique as a practicality. And until that happened, open pollination of roses was the hybridizing rule, encouraging crosses between different roses by placing them in close proximity to one another, sometimes even by placing different roses in the same planting hole.

Seeds were sown by the hundreds of thousands, and the seedlings selected and distributed if worthwhile. But the method was, at best, catch-as-catch-can: Although the seed parent could be identified, the pollen parent could only be suspected on the basis of its proximity to the seed parent and/or on the basis of suggestive features in the offspring. To complicate matters further, the genetics of repeat blooming was incompletely understood. (With a recessive gene in control of the repeat-blooming trait, the cross of a repeat bloomer with a once-blooming species results in once-blooming plants in the first generation. Selfing within that generation is then needed to bring together the two recessive genes needed to produce repeat-blooming plants in the second generation.) Nor did growers of that day know about the chromosomal-complement cause of sterile offspring. (The China Tea roses were diploid — that is, they had two sets of chromosomes — while most European roses were four-set tetraploids. Halving the sets of chromosomes for subsequent sexual union usually pro-

duced triploids, which are sterile, making it impossible to breed the second generation needed to produce such recessive-gene traits as repeat blooming. A similar problem is faced by modern hybridizers who try to breed the hardiness of our Colorado native *R. acicularis,* which has six or eight sets of chromosomes, into their tetraploid Hybrid Tea lines.)

The China-Teas are at their best in the south of France, in California, and in the states of the Old South — all areas where they are not required to withstand the wintertime rigors of temperatures that drop to (and below) 0°F. But Old Blush, the hardiest of the group, can, with proper care, survive in Colorado's climate. *R. chinensis viridiflora,* the Green Rose, is even hardier than Old Blush, but it is also very different: its bloom "petals" are actually green sepals which become red-tinged as they age. Mutabilis (*R. chinensis mutabilis*), an entrancing large bush that does well in warmer climes than ours, features flame-orange buds that open into delicately-waving yellow petals which gradually change to pink and, eventually, to coppery-crimson (a color heritage noticeable in some of our most popular modern roses).

The first known cross of a rose of the China group was with one of the *Rosa moschata* (Musk) group; the result was the cluster-flowered Noisette, which was very tender and soon, therefore, displaced by the better Teas. The Bourbon roses, on the other hand — the result of that early cross between Pink China and Autumn Damask — combined the best qualities of each parent, including reliable repeating, and are still considered handsome and desirable today. (Roses of a similar cross but lacking the repeat-blooming trait of the Bourbons are called Hybrid Chinas.)

La Reine Victoria and Souvenir de la Malmaison, both of which are large of flower and of bush, represent the best in old-rose style, while Honorine de Brabant and Variegata di Bologna are noted for flowers that are globular in form and striped in pattern. And Zephirine Drouhin, a climber with cerise-pink flowers, is valued by patio people for its thornlessness and sweet scent.

A new class of rose, the Portlands, appeared in about 1800. A melding of Gallica hybrids and Chinas, the Portlands include Rose du Roi, a double crimson that is sufficiently hardier than its China predecessors to survive here (though it really thrives in more equable climates). Another dose of China-Tea, the crossing of Hybrid Chinas with Portlands as well as with Bourbons, led to the class called Hybrid Perpetuals; and yet one more infusion of China-Tea, this time into the Hybrid Perpetual class, gave us today's commercial Hybrid Tea — a plant with a history extending back to the 1867 introduction of La France.

The "Great Age" of the Hybrid Perpetuals was the forty years between 1840 and 1880, almost half a century in which thousands of the class were in commerce and of such value that hundreds are still available today. The Perpetuals' characteristically tall plants, heavy foliage, and overwhelming show of bloom required more fertilizer, water, and predator care than that needed by their thriftier predecessors; compared to our modern Hybrid Teas, they stand taller and have heavier canes, lush foliage, and a wealth

of June bloom that can be overwhelming. Although they epitomized the globular bloom, classic rose colors, and striped patterning of old-style European roses, they were eventually displaced by the Hybrid Teas — first, because florists wanted a longer and tighter bud with better lasting qualities, and, secondly, because gardeners needed more compact bushes and wanted those bushes to feature a broader spectrum of yellow and blend colors. Yet another desirable characteristic — a more even output of bloom throughout the length of the season — brought Hybrid Teas and the related Floribundas and Grandifloras to the center stage occupied until then by the Hybrid Perpetuals.

The legacy of the grand race of Hybrid Perpetuals include an illustrative four that happen to have been the heads of four great families. Although the rose-and-lilac-colored La Reine, which was justifiably used in every illustrated text of its time, may, inexplicably, no longer exist, the other three are still available to contemporary gardeners: Baronne Prévost, which has a rich-pink broad bloom that retains the appealing quartering and button eye of its ancestors; Géant des Battailes, which was the first true-crimson descendent of Rose du Roi; and General Jacqueminot (known to Americans as "General Jack"), the first in a whole battalion of dark-crimsons with rare fragrance.

For many enthusiasts the category "Old Garden Roses" has been expanded to include hybrids like the Rugosas, Eglanterias, and Scotch roses; the gardens of those rose fanciers may be further brightened by the addition of Ramblers, Polyanthas, and some decorative species roses. Although these classes are descendants of the group called Modern Shrubs — the results of hybridizers crossing modern flower forms and colors with various species in order to acquire different styles of inflorescence and petal arrangement and, sometimes, increased hardiness and disease resistance — the fact that their history is separate from that of the European and Asiatic roses described above should not preclude their inclusion in present-day rose gardens . . . . especially not when their inclusion can broaden the spectrum of past discoveries and future possibilities illustrated by the contemporary rose garden.

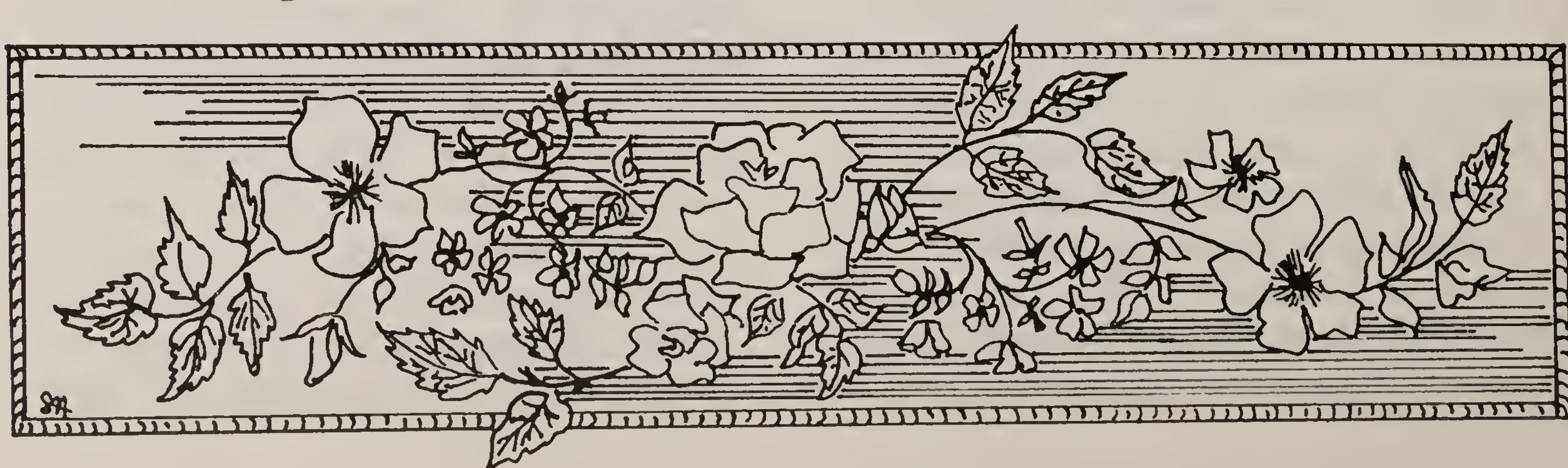
References

Shepherd, Roy E., 1978. *History of the Rose.* New York: Earl M. Coleman, Publisher.

Thomas, Graham Stuart, 1971. *The Old Shrub Roses.* London: J. M. Dent and Sons, Ltd.

Thomson, Richard, 1959. *Old Roses for Modern Gardens.* Princeton, N.J.: D. Van Nostrand Company, Inc.

Young, Norman, 1971. *The Complete Rosarian.* London: Hodder and Stoughton.



Exotics of Colorado

Bachelor's Button

Centaurea cyanus

Helen Marsh Zeiner, Ph.D.

An early English botanist suggested that bachelor's button, a very old English common name for *Centaurea cyanus* L., may have derived from the flower's resemblance to the "jagged cloathe buttons anciently worn in (the British) kingdom." But English gardeners, who use the name bachelor's button for 21 other plants as well, also know *Centaurea cyanus* by a number of other, less readily explicable, names: ragged sailor and loggerhead, for example, not to mention break-your-spectacles and hawdads.

In pink, purple, white, and blue

Although plant breeding throughout the years has given contemporary gardeners white, purple, and pink bachelor's buttons, the original *Centaurea cyanus* was blue — the species name, "*cyanus*," being the Greek word for blue — which explains such other English common names as bluet, blue bottle, and blue bonnet.

Helen Marsh Zeiner, Ph.D., is honorary curator of the Denver Botanic Gardens' Kathryn Kalmbach Herbarium and a member of the gardens' editorial committee; she is also a former editor of, and frequent contributor to, *The Green Thumb*. Dr. Zeiner also taught botany at the University of Denver.

In southeastern Europe, the area to which it is indigenous and where it often grew as a weed in grain fields, *Centaurea cyanus* was called cornflower (a name by which we still know it today) or, because its rough stems dulled the sickles used to reap grain, hurt-sickle.

And in Germany, where it is called Kaiserblume, Emperor William I is said to have made *Centaurea cyanus* the national flower of his country to commemorate its role in a royal-childhood event: When William's mother, Louise of Prussia, was forced to flee Berlin as Napoleon approached the city in 1806, the carriage in which she and her two young sons were riding broke down. To amuse William and his brother while the carriage was being repaired, Louise had the children gather cornflowers, which she then wove into wreaths for them. Sixty-five years later, William still remembered those wreaths and, upon becoming the first emperor of Germany, he designated the cornflower, which reminded him of his mother, the national flower of his country.

Always in fashion

Fashions in flowers, as in clothes, may come and go, but *Centaurea cyanus* — by whatever name — is as popular an annual in the

Centaurea cyanus, Bachelor's button

gardens of today as it was in those of our grandmothers' times. Requiring no special care, it is one of the easiest of all annuals to grow: It comes readily from seeds, does well in partial shade as well as in sun, and is valued as a cutting flower because its colorful blooms come into flower early and continue to flower, if the seeds are kept picked off, until frost.

A slender, branching plant, bachelor's button usually grows to one or two feet in height. Its small leaves, which are wooly-white when very young and grayish-green in maturity, are linear; although they are usually entire, they are sometimes toothed or coarsely pinnatifid.

The heads of *Centaurea cyanus* are solitary on slender stalks or peduncles, and their structure shows that they belong to the composite family. (The genus *Centaurea* has heads composed of disk flowers only. Although enlarged and elongated marginal flowers may, at first glance, appear to be ray flowers, close examination will reveal that they, too, are indeed disk flowers.) In addition to expanding the color range of *Centaurea cyanus* — from the original blue to white, various shades of pink, purple, and blue, and two-toned combinations of those varied shades — plant breeding has given us a choice of double as well as single forms of this enduringly popular flower.

In ancient legend

Plants known in antiquity were frequently mythologized by the ancients, and bachelor's button is no exception. Chiron, who in Greek mythology was the leader of the centaurs — a wise man who instructed Grecian youths, including Hercules, in music, medicine, and weaponry — is said to have used crushed cornflowers to heal a wound infected by the poisonous blood of a nine-headed hydra. (Legend has it that Hercules, sent to kill a hydra, was greeted upon his triumphant return by Chiron; accidentally, one of Hercules's arrows, tainted by the blood of the slain hydra, fell on — and pierced — the centaur leader's foot.) Thus did bachelor's button become known as *Centaurea* (which has come to mean "healing"), the name used by Pliny, a Roman botanist who lived from 23-79 A.D., to describe the plant from which his contemporaries prepared 20 different remedies!

In gardens and along the road

Other common garden flowers belonging to the genus *Centaurea* include sweet sultans, basket flower, knapweed, and several low-growing species with white tomentose foliage called dusty miller. And two introduced species of *Centaurea*, both of them called knapweed, grow as common weeds along Colorado highways.

References

Bailey, L. H. 1943. *The Standard Cyclopedia of Horticulture*. New York: The Macmillan Company.

Beals, Katharine M. 1917. *Flower Lore and Legend*. New York: Henry Holt and Company.

Quinn, Vernon. 1939. *Stories and Legends of Garden Flowers*. New York: Frederick A. Stokes Company.

A "Treasure Hunt" for Three "Missing" Orchids

Stephen Blecher

In 1966 *Empire Magazine* of *The Denver Post* featured an article on native orchids of Colorado, an excerpt from a Denver Museum of Natural History publication written by the late John C. Long, M.D. We had recently moved to Colorado, and I was surprised and fascinated to learn that 22 species of orchids grow in our mountains. Knowing very little about botany at the time, I assumed that orchids were found only in the tropics. Since it seemed a good way to explore different areas of the state, my wife, Natalie, and I set out to find some of the species that Dr. Long described.

We were quickly rewarded and found and photographed most of the orchids during the next few summers. They alway grow in the most beautiful spots, and in a few instances Dr. Long graciously gave us detailed directions.

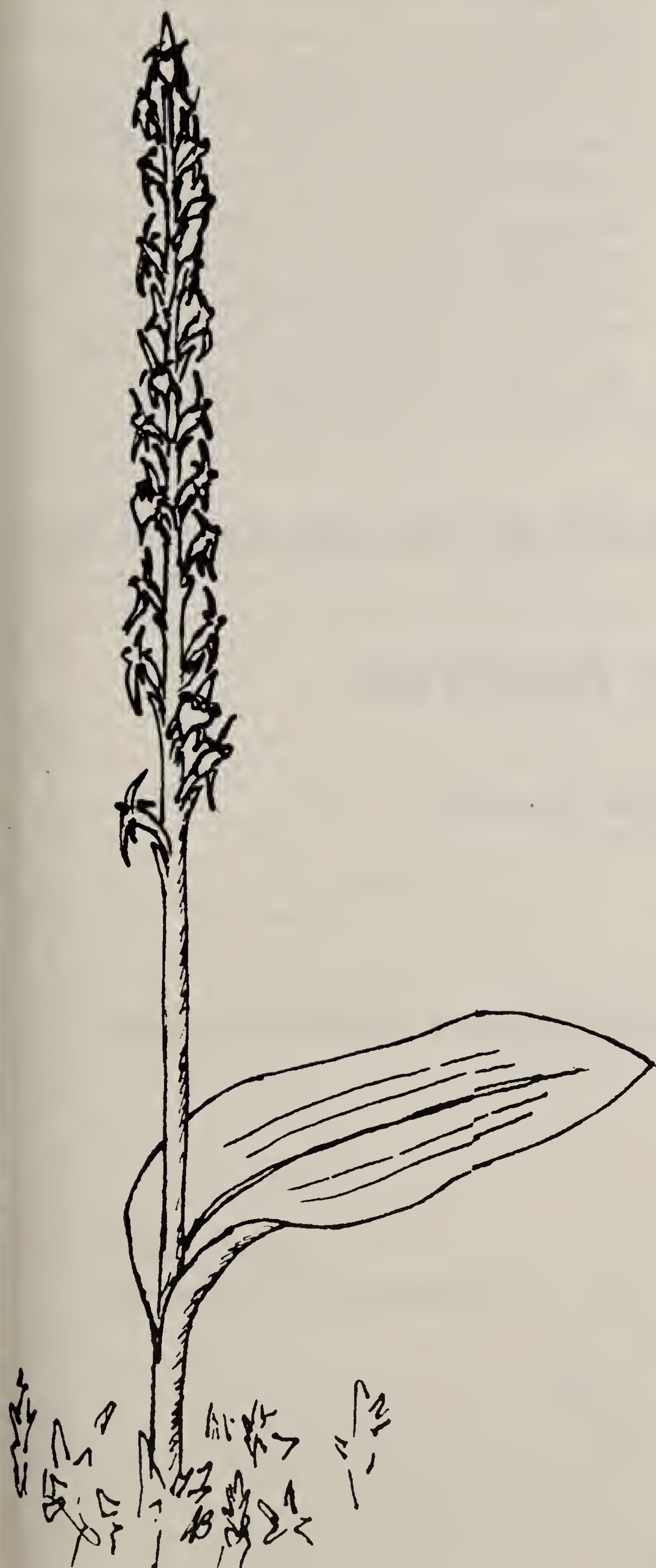
When Dr. Long wrote his book he had been unable to locate three species because of their extreme rarity. These were *Malaxis brachypoda* Gray, reported only once, in 1906, on Green Mountain near Boulder; *Goodyera repens* L., found on Pike's Peak in 1923; and *Listera borealis* Morong, found near Gothic in 1961. (They have no common names, only scientific.) I thought it would be exciting to rediscover them but held little hope for locating all three.

Nonetheless, I paid a visit to Green Mountain since good hiking trails there make for a pleasant outing. This area is very lush and criss-crossed by tiny streams running through small but deep ravines. I climbed down the bank of one stream and proceeded along its bed. It was slow going with heavy undergrowth and fallen logs blocking the way; also, I was loaded down with camera gear. After inching along for a couple of hundred yards I came upon a bed of *Listera convallarioides* Sw., rare in Colorado. This little orchid has two broadly oval, brilliant green leaves spread horizontally halfway up its stem and topped with several pale green translucent flowers. With this bit of encouragement I felt a glimmer of hope of finding malaxis farther upstream. Sometimes the way was

---

Stephen Blecher is an accomplished amateur photographer and botanist, many of whose photographs appear in *Wild Flowers of the United States*, a multi-volume reference work published by The New York Botanical Gardens. When he is not seeking and photographing Colorado flora, he works as an optical and mechanical engineer for Martin Marietta, where he designs scientific instruments for space exploration.

completely blocked with fallen trees, and I had to climb up the steep bank and back down again. More beds of listera appeared but not a sign of malaxis. I explored several streambeds during the remainder of the summer, a slow process since it was impossible to



Malaxis bracypoda
(Pictured twice normal size.)

cover more than half a mile per day. The year ended without my quest rewarded.

The following June I was photographing an exceptionally large bed of calypso orchids growing on a shaded slope near Wellington Lake. After the picture-taking session I packed up my cameras and started back down the slope. A branch protruding from a fallen tree caught my gadget bag, and when I bent down to free it I noticed some rosettes of unusual looking leaves growing flat upon the ground. They were about an inch long with rectangular dark green patches on a lighter green background, very decorative looking. This could only be the foliage of the long-missing *Goodyera repens*! Since the genus *Goodyera* blooms in August I made a note to return later for final identification.

Hope springs eternal, and with this stroke of luck in apparently finding goodyera fresh in my mind, I decided upon another assault on Green Mountain. After several more futile trips I was ready to give up since I had covered the large stream along the main trail and all the small ones branching from it. In a last ditch effort I started along the main trail once again, re-checking ground already covered. This time I noticed a small trickle of water flowing down a rock face on the stream's opposite side, so I crossed over and climbed its bank. From the top of the bank the trickle disappeared into a narrow ravine not visible from the trail. This water would flow underground and re-emerge in pools no bigger than saucepans. Each pool was ringed with moss and *Listera convallarioides*. Since this ravine was too

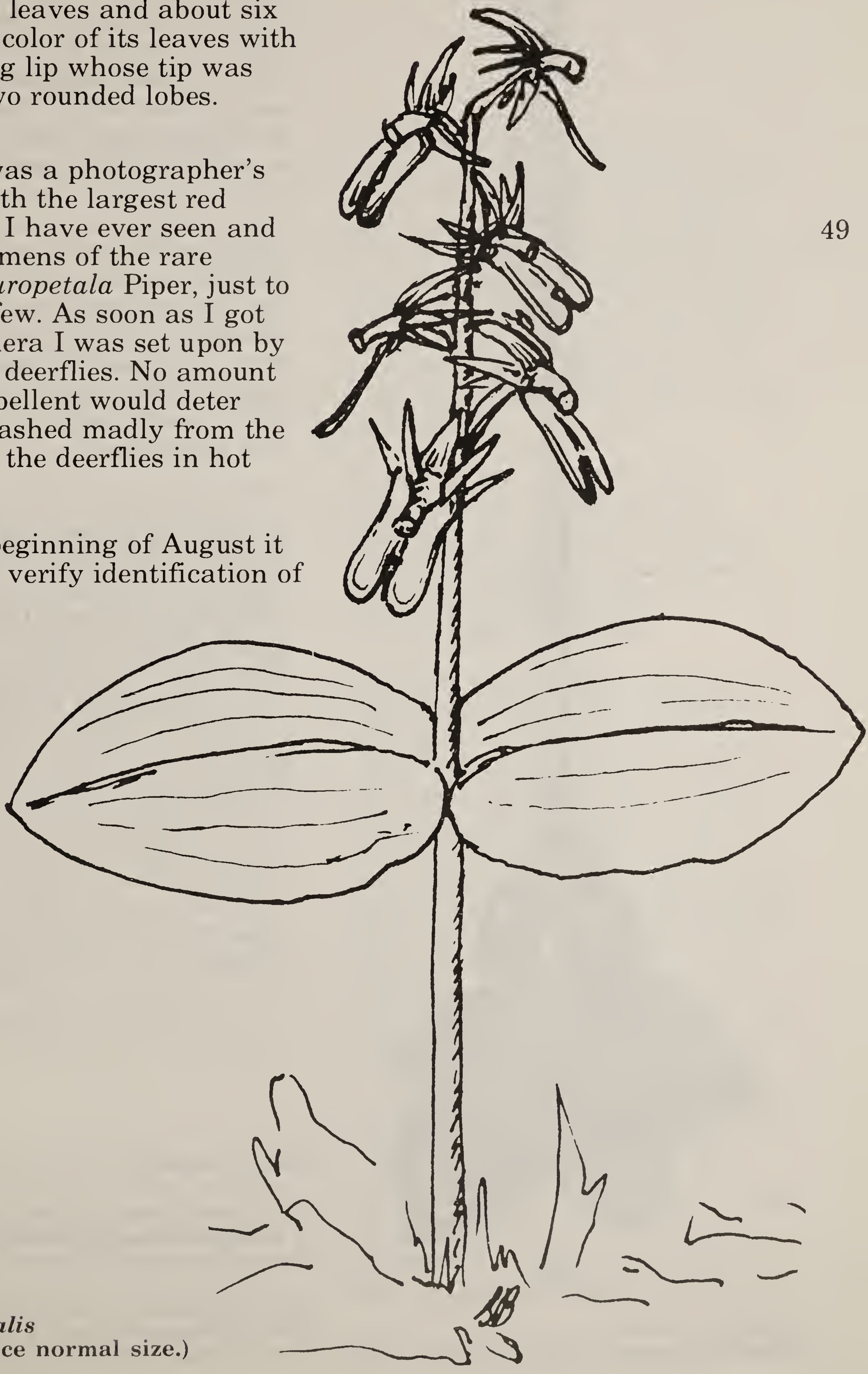
narrow to negotiate in most places the only way to examine it carefully was to climb part way down the bank every few yards for a closer look at the bottom. But now another encouraging sign: *Piperia unalascensis* s. Watson, a very rare bog orchid with a slender stem carrying tiny green flowers. A bit farther up the mountain the ravine opened into a level spot a few feet wide where the stream branches into several even smaller trickles, forming miniature islands of thick moss. On one island stood five plants, each with only one shiny leaf partly sheathing a stem no taller than three inches and thin as a cat's whisker. In two tight rows along the stem were about 50 minute white flowers with pointed petals, each flower the size of a typewritten asterisk — *Malaxis brachypoda*!

I photographed these plants and, with some regret, collected one specimen to take to Dr. William A. Weber, curator of the University of Colorado Herbarium. He was delighted since the herbarium had no specimens of malaxis. He told me that he had found *Listera borealis* near Gothic the previous summer and described its location. Its blooming time was then so Gothic was my destination the following weekend. Gothic is reputed to receive 70 inches of precipitation per year and the area has an exceptional profusion of wild

flowers. For two days I searched through dense woods without seeing listera. On the third day I found a group of three plants of *Listera borealis,* a rather drab species with two opposite dull green ovate leaves and about six flowers the color of its leaves with a flat oblong lip whose tip was cleft into two rounded lobes.

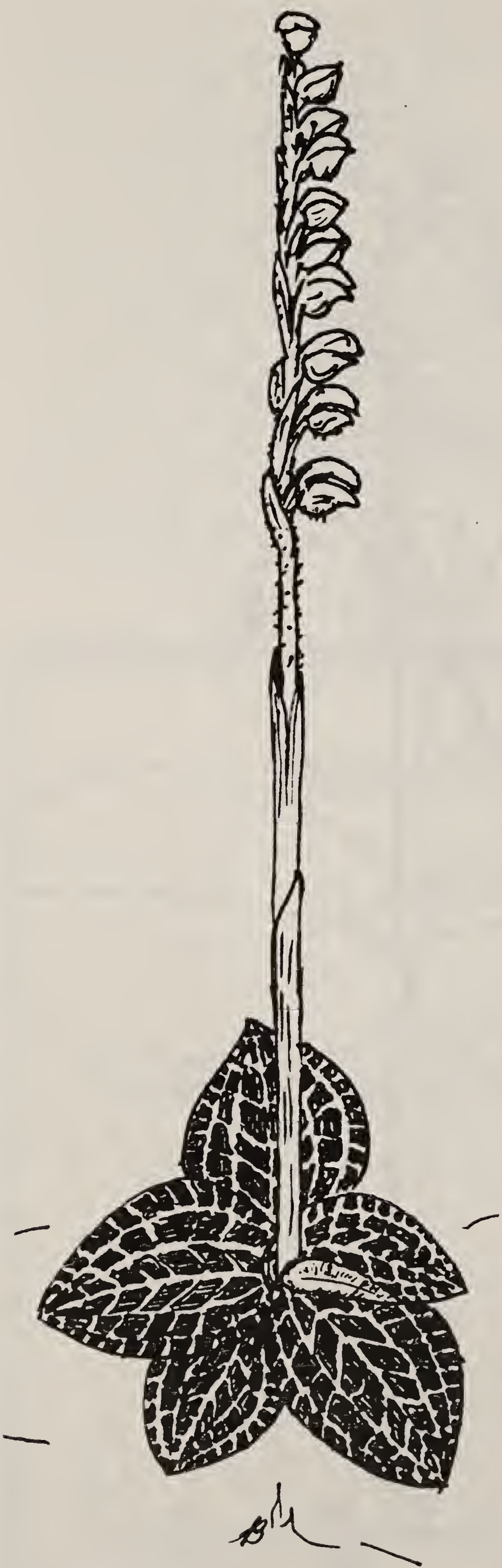
This area was a photographer's paradise with the largest red columbines I have ever seen and prime specimens of the rare *Mitella stauropetala* Piper, just to mention a few. As soon as I got out my camera I was set upon by a swarm of deerflies. No amount of insect repellent would deter them so I dashed madly from the woods with the deerflies in hot pursuit!

About the beginning of August it was time to verify identification of goodyera near Wellington Lake where I had located the foliage. The plants were blooming with



Listera borealis
(Pictured twice normal size.)

eight-inch high racemes of hooded white flowers, typical of the species. From that spot it's a quarter mile walk to the road and just before the road is a boggy stream. As I walked along the bank seeking the easiest place to jump across — there in the moss at the base of a tree stood a dozen prime specimens of *Malaxis brachypoda* no more than 50 feet from my car! I could have saved two years of effort, but no matter: accidental discoveries are the essence of plant hunting.



Goodyera repens
(Pictured normal size.)

All this time spent in the woods yielded not only orchids but many equally rare and interesting species of other families. The plant communities of the moist forests contain such exotics as members of the heath, gentian, saxifrage, and violet families.

On one trip I discovered a tiny gentian, tentatively identified as *Gentianella propinqua,* not previously reported from Colorado. Just last year another botanist discovered a new orchid for this state, believed to be *Spiranthes cernua.* Dr. Weber has several discoveries to his credit as do George Kelly, Ruth Ashton Nelson, and others. No doubt other plants beckon to persistent plant hunters. This summer you may want to try your hand at it but please do your hunting with a camera.

References

Long, John Chennault, 1963. *Native Orchids of Colorado* (*Museum Pictorial No. 16*), Denver Museum of Natural History.

Weber, William A., 1967, *Rocky Mountain Flora.* Boulder, Colorado: University of Colorado Press.

The Devil's Walking Stick Can Be Seen in City Park

Frederick W. Lenhart

Of all the unusual trees and shrubs that grow in Denver's parks, surely one of the most interesting is the devil's walking stick, *Aralia spinosa* L., which can be found at the southeast corner of City Park. (Its precise location is 48 paces north and 20 paces east of the northwest corner of the intersection of Garfield Street and Seventeenth Avenue.)

Also known as Hercules club, this small tree or large shrub features an array of formidable bristles — the spines from whence the name "*spinosa*" derives — on its leaves, twigs, branches, and trunk. And though the ones that grow in Colorado, including our City Park specimen, are uniformly low in height, devil's walking sticks in other parts of the country, particularly those in the southeastern states, can grow to imposing heights of more than 30 feet.

One of several hardy trees and shrubs grown for their ornamental foliage, the devil's walking stick has large, double-pinnately compound leaves arranged alternately on its twigs, with 25 or more leaflets comprising a mature leaf. Close observation shows that the egg-shaped leaflets are toothed, pointed, and sessile, and that they have rounded or broadly pointed bases. The leaf scars, which are long and narrow, have about 20 noticeable fibrovascular bundle scars and encircle the twigs nearly halfway.

The brownish buds of devil's walking stick, which are only about a quarter of an inch long, have very ragged-edged scales, and those along the stem are flattened and appressed.

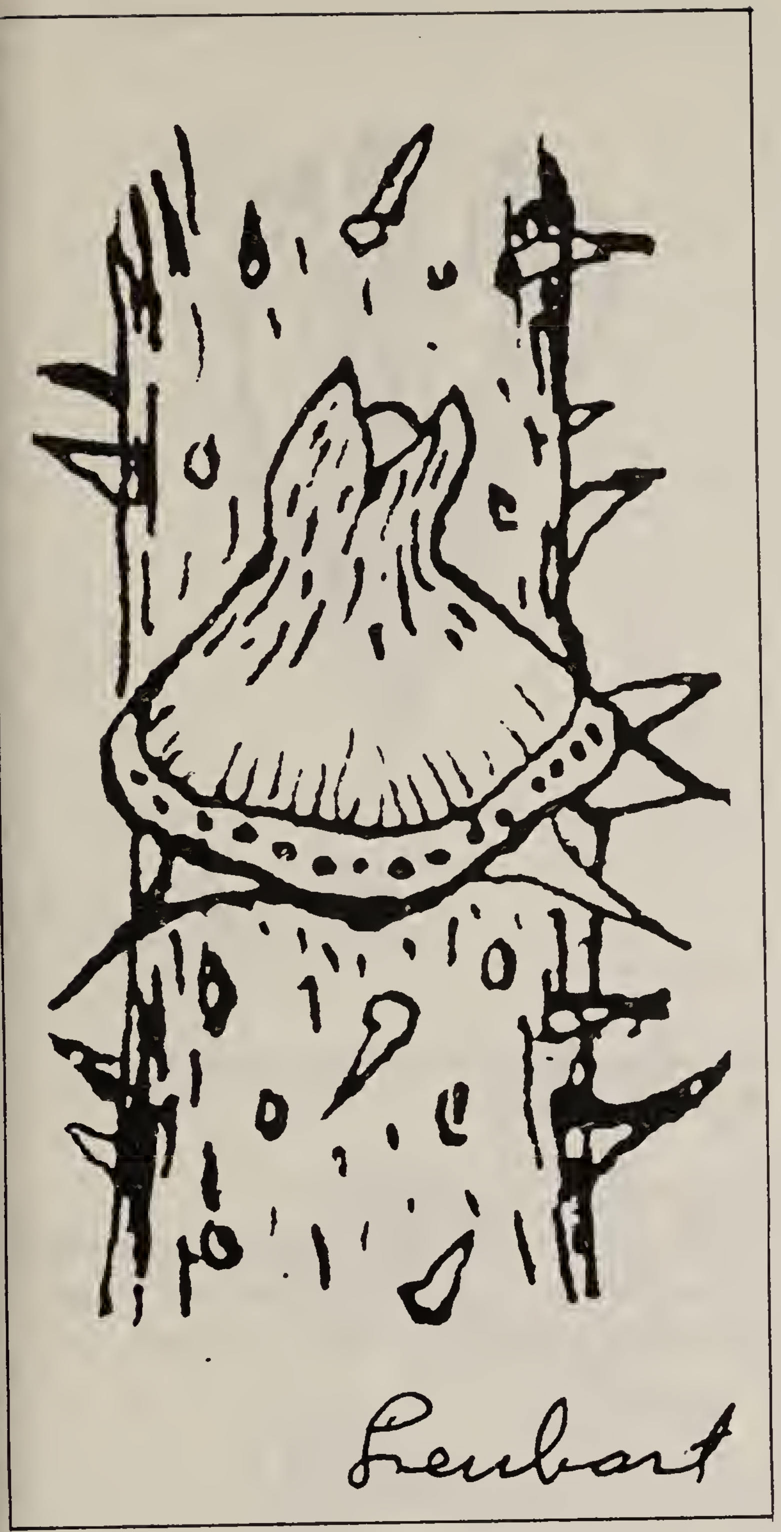
Depending on climate and soil conditions, devil's walking sticks show their small clusters of whitish flowers in July, August, or September, with the berry fruits maturing between August and November. The berries, which are five-seeded, fleshy, and black, provide food for many species of wild birds, and since the seeds are not digestible by the birds, they are widely distributed below the telephone lines and fences on which birds perch.

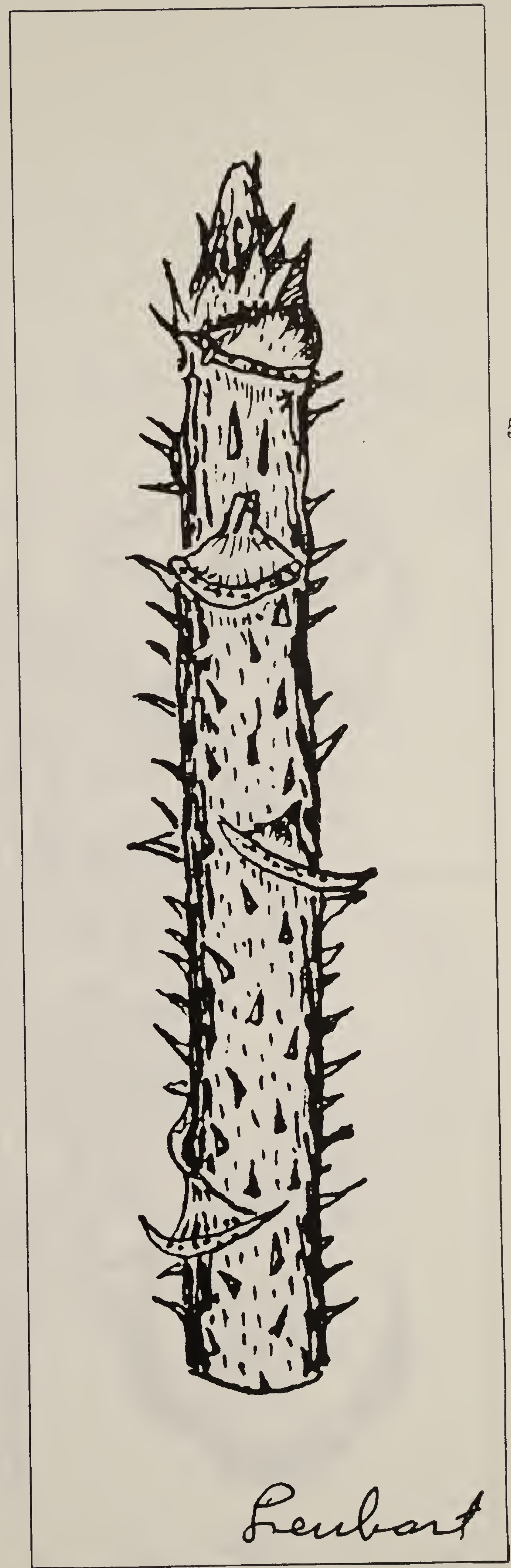
Most shrubby species of aralia are native to Korea, Japan, China, and the North American continent, where they thrive in ordinary garden soil and can be propagated by sucker growth, seeds, or grafts. Regular pruning

Text continued on page 56

An alumnus of the New York State College of Forestry, Frederick W. Lenhart is known to many readers of *The Green Thumb* as the leader of the tree-walks sponsored each summer by the Denver Museum of Natural History. Mr. Lenhart is co-captain of the museum's security force and the author of *117 Trees and Shrubs*, a book carried by many tree-walk participants.

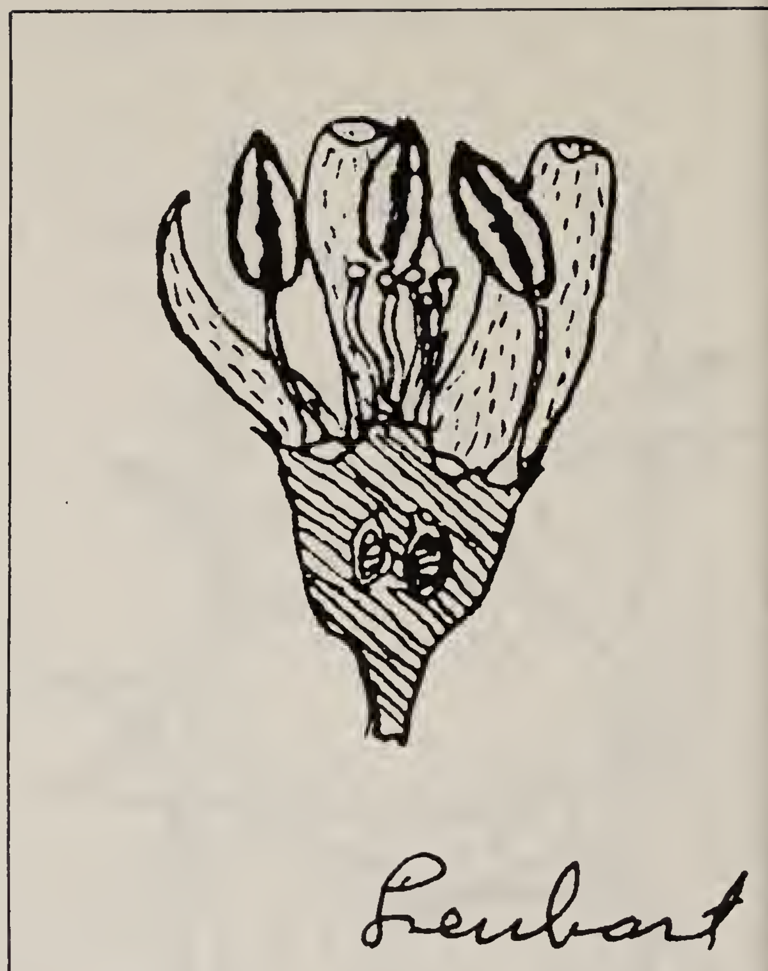
Note: The following illustrations are not normal size.





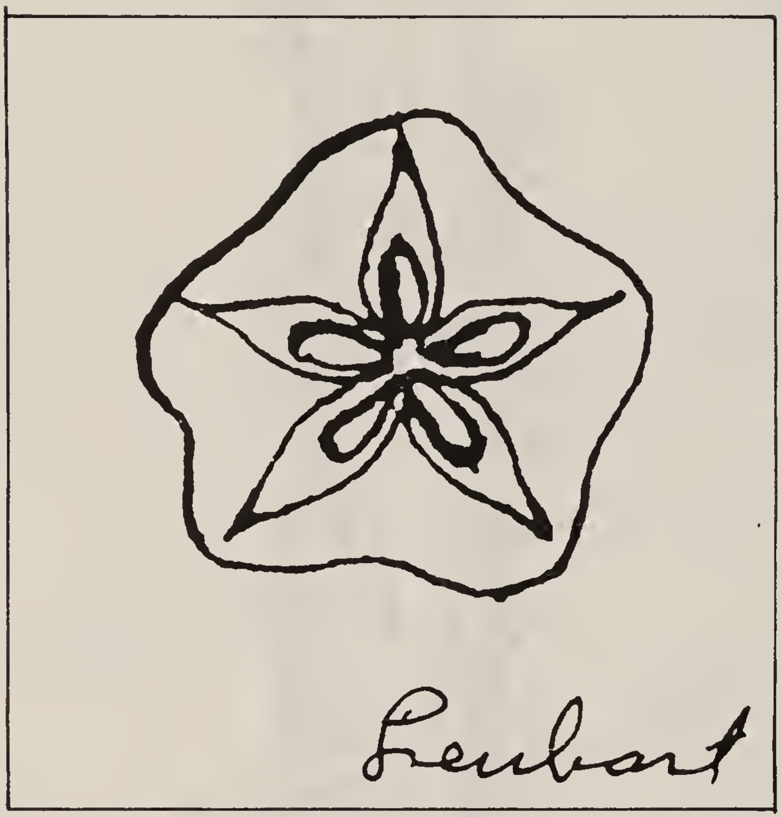
Aralia spinosa
The Devil's Walking Stick –

A winter twig (right)
A leaf scar and bud (above)
A doubly-pinnate compound leaf (opposite)



Fruit and Flower of the Devil's Walking Stick —

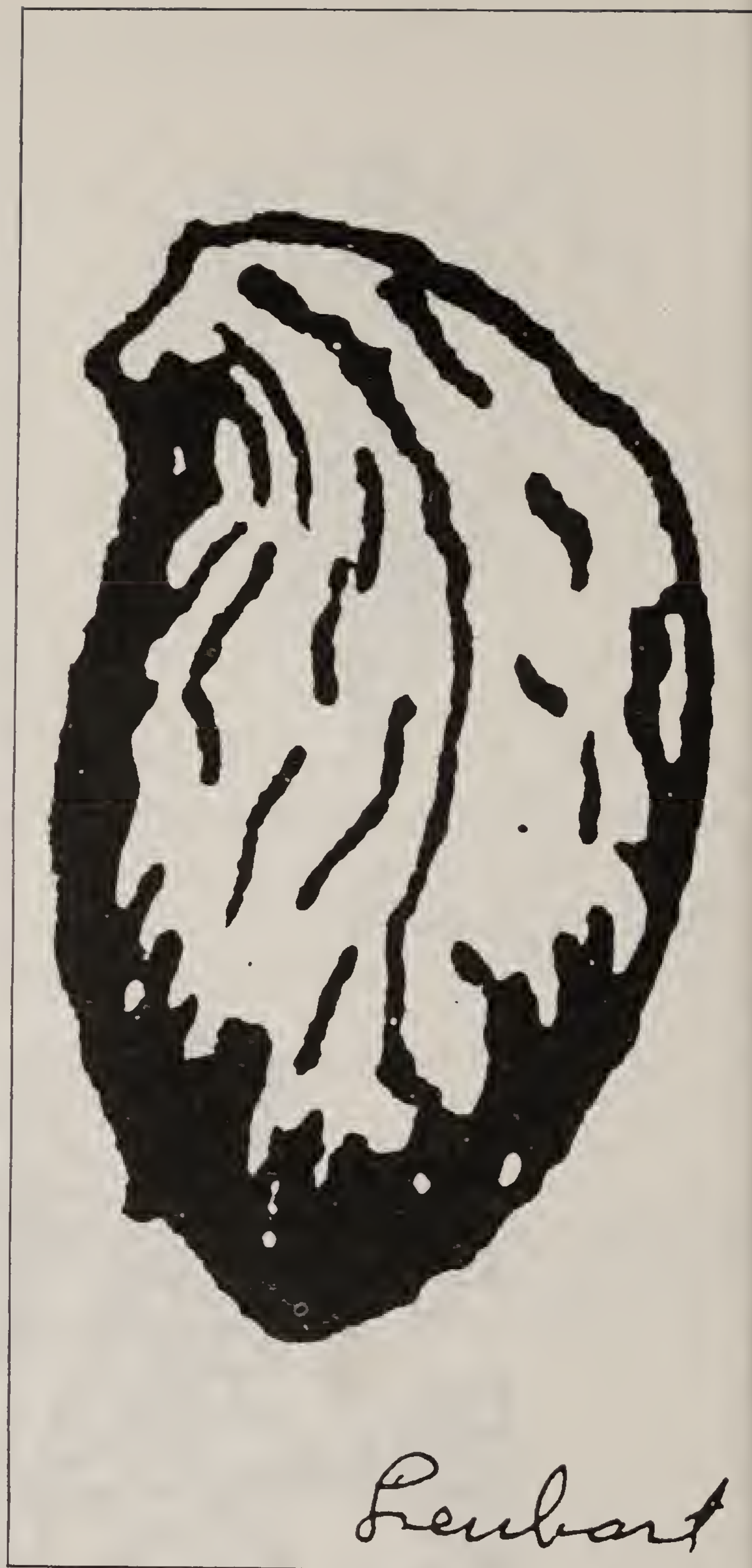
A perfect flower (above)
End portion of a fruit cluster (opposite)
Apical view of fruit section (left, top)
Apical view of fruit (left, bottom)

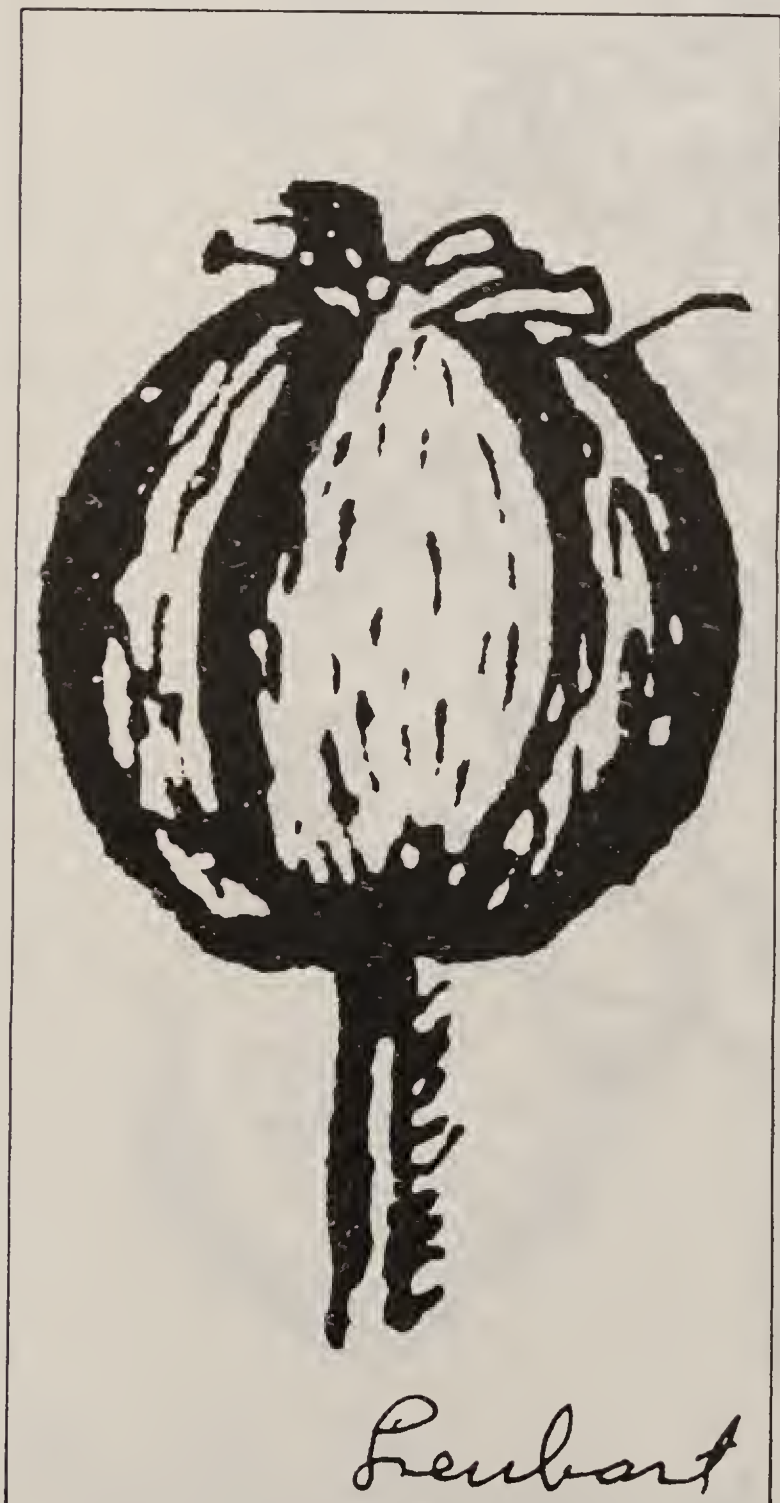


Text continued from page 51

is not required, but the devil's walking stick, which spreads by suckers, should be given plenty of room to expand its growth.

Local nurseries may be a source for two American herbaceous aralias: *Aralia hispida* Venten., which is called bristly sarsaparilla, and *Aralia californica,* S. Wats., or elk clover, a stout perennial native to the Pacific northwest.





Berry and Seed of the Devil's Walking Stick —

One seed (above)
Five-angled black berry tipped with persistent styles (left)

References

New Illustrated Encyclopedia of Gardening, 1972. New York: Greystone Press.

Harlow, William H., 1917. *Trees of the Eastern and Central United States and Canada.* New York: Dover Publications, Inc.

The Rock Alpine Garden in Historical Perspective

Panayoti Peter Callas

Located in the southwest corner of the botanic gardens, the Rock Alpine Garden, which enters its second year of operation this summer, offers visitors an especially appropriate view to the west: Through the mature forest of Cheesman Park's conifers, it is possible to see the snowcapped peaks of the mountains that served as source and model for many of the garden's plantings and as inspiration for much of its rock work.

But visitors may wish to look as well in another, more abstract but nonetheless appropriate, direction: backward through horticultural history, to the development, in the last half of the 19th Century, of the classic English rock garden. For what gives the Denver Botanic Gardens' rock alpine garden an exciting new dimension is its graceful combination of such classic English rock garden features as the moraine, screes, and wall gardens with such unique western-landscape innovations as the fellfield, boulder field, a limestone rock face, and a pumice ledge.

Although it's hard now to imagine a time when garden forms we take for granted — perennial borders no less than rock gardens — were considered shocking, there was tremendous resistance, especially among established garden writers and landscapers, when William Robinson and Gertrude Jekyll first articulated them in the Victorian era. But the currents of romanticism ran deep and hard through the gloomy piety of Victorian England: middle-class readers were enthralled by newspaper accounts of the explorations (and exploits!) of Speke, Stanley, Livingstone, and Burton, and droves of middle-class gardeners were soon smuggling plants instead of more conventional souvenirs back from their vacation travels in the Alps.

Not to be outdone by the hoi polloi, upper-class owners of estates theretofore landscaped in planting patterns best described as rigidly symmetrical hired on armies of rock gardeners to fight the battles of what had become a veritable war of rare-specimen collection and natural-plantings landscape design. (The war may have reached its climax in Warley, where an Edwardian lady named Miss Willmott eventually employed a staff of 85 gardeners to maintain

---

Panayoti Peter Callas, a frequent contributor to this publication, is curator of the Rock Alpine Garden.

Saxifraga (Engleria type)

the *au naturelle* appearance of her extensively rock-gardened estate.)

Looking back on the tradition inherited by Victorian gardeners, we can see why they were so excited by this new garden form. For countless generations, from the very beginnings of agriculture and horticulture, the repertory of garden plants had been small: a few flowers and vegetables, a few herbs, and a few trees and shrubs. And these few specimens were invariably grown in the most convenient and efficient way possible: in rows and lines, in blocks and lots.

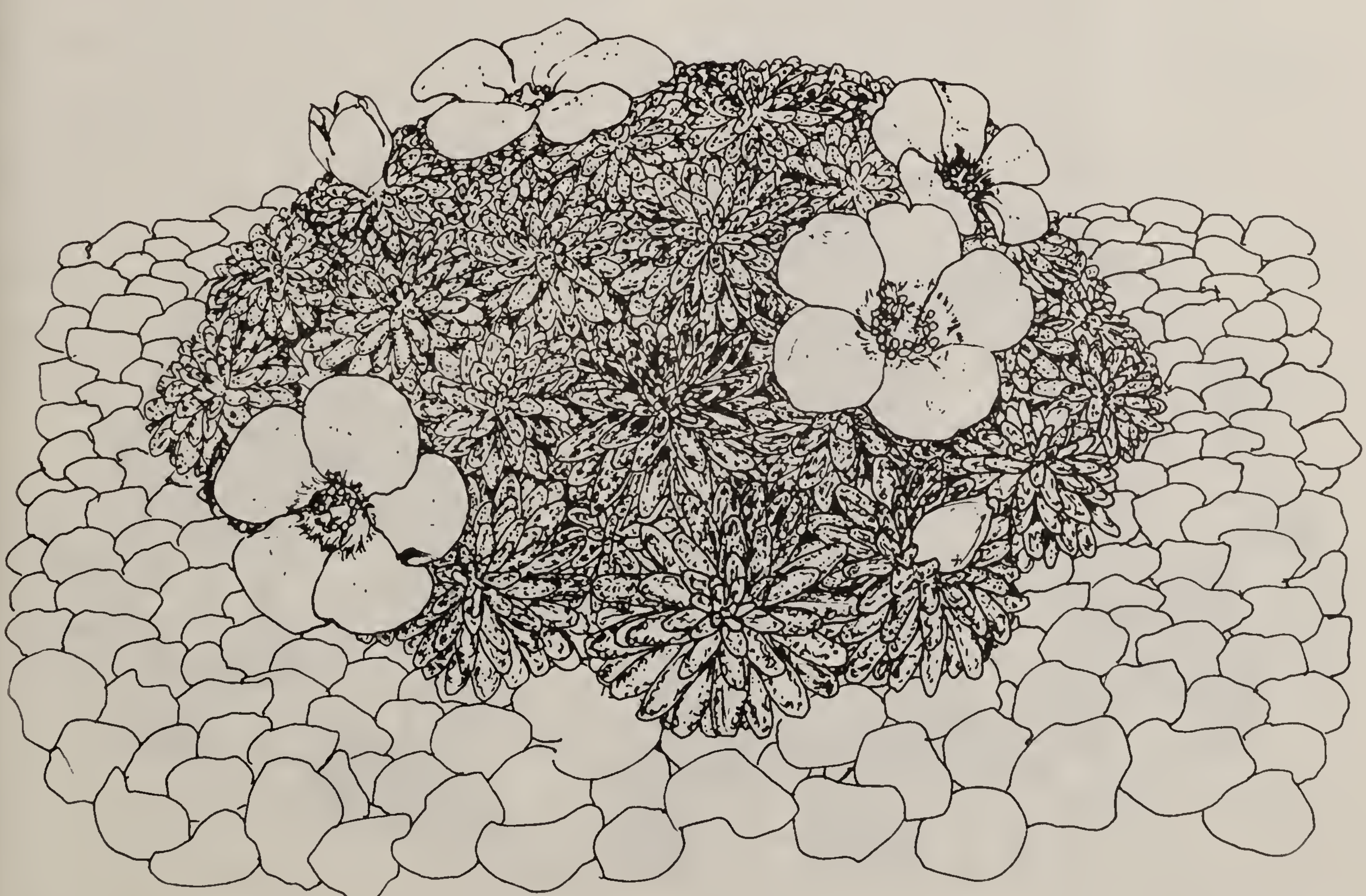
Accustomed to seeing "darkest" Africa as a blank and ill-defined land mass on their maps, Victorian gardeners were equally accustomed to extremely limited horticultural options. But just as English explorers were expanding the horizons of their Empire by filling in blanks on its maps, a new and naturalistic mode of gardening expanded the horticultural horizons of those who stayed at home. And the adventurers traipsing through uncharted lands abroad contributed to the expansion of their homeland's horticultural horizons by carrying back with them seeds and propagules from the far corners of the world. The "stove" gardens of Victorian England soon bristled with exotic plants from faraway lands, and the country's outdoor gardens rapidly became, collectively, the repository of many exciting examples of the temperate flora of the world.

Originally articulated as a

botanical bridge between the city and the natural landscape beyond it, the Victorian rock garden developed, in the years prior to World War I, into a microcosm of the world's mountain landscapes. And its finest exemplars recalled not just mountain vistas but the loveliest of *all* mountain vistas!

But the Victorians were nothing if not emphatic about the moral-uplift potential of education: the aesthetic pleasure derived from looking upon the microcosmic mountain vistas of their rock gardens would have to be combined, in proper Victorian fashion, with an instructional — morally uplifting — opportunity to learn each plant's scientifically correct name, reference, and geographic origin. Whole neighborhoods in England thereupon metamorphosized into living herbaria in which the mats and hummocks of microcosmic mountain vistas, the hundreds of alpine flowers lined out in "naturally" curvy rows, were, for the edification of all who viewed them, carefully labeled with the Latin name, reference, and country of origin of each specimen.

And it worked! The Victorians' successful integration of aesthetic quality and scientific accuracy made the English rock garden an essential component of botanic gardens throughout the world, encouraging increasing numbers of dedicated amateurs to pursue the art and science of rock gardening with talent and knowledgeability as well as enthusiasm. Here in Colorado, where early gardeners were able to see and learn from the millions of natural rock gardens scattered throughout the Rockies, the "new" garden form got off to an early, and widely admired, start. D. M. Andrews's Rockmount Nursery in Boulder, for example, is mentioned repeatedly in *The English Rock*

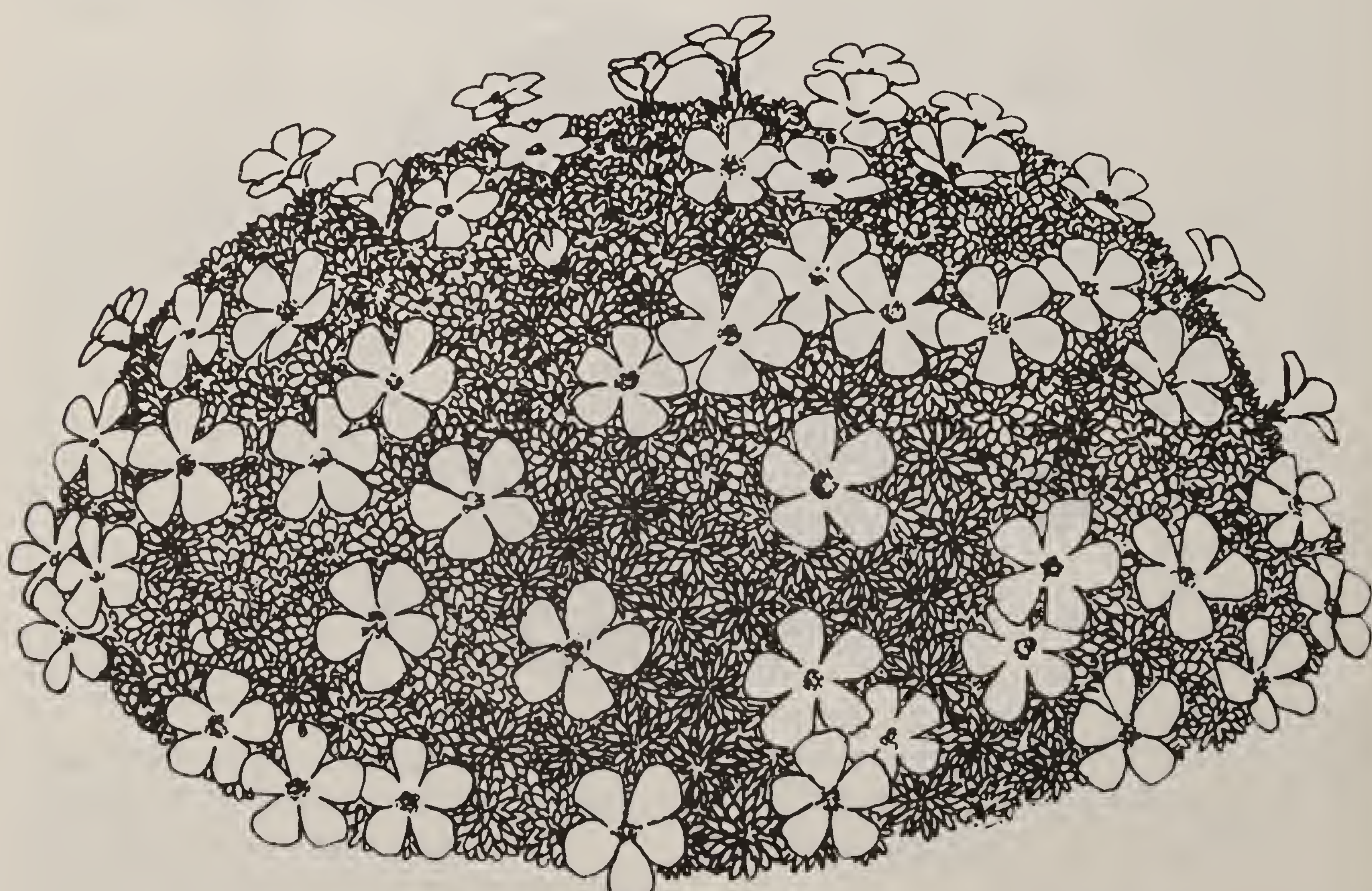


Saxifraga 'Cranbourne'

Garden, Reginald Farrer's classic monograph on the subject. Kathleen Marriage of Colorado Springs was respected internationally for her writing as well as for her nursery work, and photographs of pioneer Colorado rock gardens can be found in many early rock garden books.

But the model provided by the natural rock gardens of Colorado's mountains was only one factor in the early development and continued interest in rock gardening in this area. The other is our climate, which is unmatched in the diversity of plant materials it permits us to grow (and to grow well).

Horticulturally, we can have our cake and eat it, too: In selecting plant materials for the Rock Alpine Garden, we were able to include specimens from many parts of the world, and our choices, not delimited by considerations of what *could* be grown here, were instead made on the basis of beauty (of form, flower, or foliage), botanical interest, and appropriateness in a garden setting. Although the bulk of the thousands of plants growing in the Rock Alpine Garden was grown from seeds obtained from botanic gardens around the world, many starts of rare plants were provided by generous local gardeners. Most of our rare trees and unusual dwarf conifers were purchased in Oregon and Washington, but some of our choicest plants were donated by visitors from other parts of the country. Hundreds of other plants in our inventory were purchased from alpine and rock garden nurseries on both coasts and in the upper midwest, and such specialty nurseries will undoubtedly continue to provide us with important material in the future.



Saxifraga x arco ralleyi

Saxifraga callosa

If we think of our plant inventory as the flesh of our garden, then surely the soil in which those plants grow is its lifeblood. Under the careful supervision of Herb R. Schaal, A.S.L.A., principal of the Fort Collins office of the landscape architecture firm of EDAW, Inc., and developer of the Denver Botanic Gardens' original master plan, soils ranging from acid peat (with a pH of 4.5) to alkaline clays (with a pH of 8.0) were selected for different areas of the garden.

But no matter how interesting soils (and their individual pH values) may be to a soil specialist, no matter how lovely and interesting our plants, the skeleton of a rock garden — its structural and contextual support — is its rocks and rock formations. And individually and, collectively, in formation with each other, the rocks in our garden are reflective of their geological history and location.

Limestone, congenial to the growth of many difficult alpine plants and the classic rock of English rock gardens, is, in a tribute to tradition, an important component of our garden. But few rock gardens, in England or elsewhere, possess limestone comparable, in elegance or in subtlety, to the massive Owl Creek boulders used in the central portion of this garden. Their deeply etched and weathered faces are encrusted with a variety of lichens, and wild shrubs and flowers still grow in their crevices. Depending on the weather — sunny or clouded over, wet, dry, or something in between — the time of day, the season of the year, and the vantage point of the viewer, the limestone used here varies in color from bright pinks to somber grays, its neutral tones providing an ideal background for the brightly-colored alpines growing nearby.

Although granite is not usually used in rock gardens, Mr. Schaal has masterfully arranged monumental granite boulders, transported from Buckhorn Canyon in Larimer County to the fellfield, boulder field, and seep areas of our garden, to mimic the rockwork found in the Pre-Cambrian backbone of the Rockies. The acidic beds over which these granite boulders tower host a wide variety of peat-loving plants.

Tufa, which is essentially a very porous limestone precipitate with an elaborately sculpted surface, was brought to the garden from a mine near Steamboat Springs. In the form of a tufa ledge, it is "home" to our choicest and tiniest alpine saxifrage, androsaces, and primulas — and quite possibly the only tufa garden in a semi-arid climate.

Our deeply eroded and weathered sandstone boulders, obtained from a ranch near Denver for use in the woodland garden, are Foxhills sandstone. Formed as a beach and wind deposit when the Mesozoic Ocean retreated from Colorado, they have a finely-textured, white surface which blends well with other rocks in the garden.

The deep-gray pumice monoliths along the northwest entrance to the garden were brought here from Arizona. Their use in this Colorado garden is decidedly experimental: Despite its porosity (which invites rock gardeners to plant directly in the rock), interesting texture and coloration, and lightweight, this rock has been used only rarely in local gardens.

Distinguishing our five different rock types is difficult from a distance, but close examination shows that the igneous rocks selected complement their sedimentary neighbors as elegantly here in the Rock Alpine Garden as in their natural settings in the foothills to our west.

And complementary relationships are the philosophical as well as physical substance of a successful rock garden. As the most ambitious rock garden constructed in the United States in this century, the Rock Alpine Garden of the Denver Botanic Gardens is committed to maintaining and strengthening those complementary relationships

References

Correvon, Henry, 1930. *Rock Garden and Alpine Plants.* New York: The MacMillan Company.

Farrer, Reginald, 1975. *The English Rock-Garden* (Two Volumes). Sakonnet, R. I.: Theophrastus Publishing.

Foster, H. Lincoln, 1968. *Rock Gardening.* New York: Bonanza Books.

Schenk, George, 1969. *How To Plan, Establish, and Maintain Rock Gardens.* Menlo Park, California: Sunset Books/Lane Book Company.

A Horticulture Training Program for the Developmentally Disabled

Gary S. Schroeder

Common sense tells us (and research has shown) that young adults with developmental disabilities can gain a stronger sense of self worth through the acquisition of salable vocational skills. The possession of such skills gives the disabled individual an opportunity, through employment in a competitive setting, to be more easily accepted into the mainstream of society.

It was with those truths in mind that the Association for Retarded Citizens in Colorado established a new vocational training center, which uses horticulture as its training medium, for developmentally disabled adults. Open — for business as well as for training — since 1979, the Horticulture Training Center (HTC) operates out of a 10,400-square-foot greenhouse and an adjacent office building located on three acres of land on South Parker Road in Aurora. Trainees referred to the HTC by the Colorado Division of Vocational Rehabilitation participate in a two-phase vocational training program.

The 1st Phase

The first phase of the center's training program runs for eight to twelve weeks and focuses on specific horticultural skills, preparing each trainee for greenhouse or other plant-care related employment. This initial training and orientation period also gives participants an opportunity to develop the personal and work-adjustment behaviors of good employees.

The 2nd Phase

The second phase of the training program — affirmative industry employment in the HTC greenhouse — emphasizes the full employment of handicapped workers in the greenhouse operation. Phase One-trained workers are now responsible for the production of marketable plants: plants suitable for sale by the center to the consumer public. Upon completion of Phase Two, they will be prepared for vocational placement in greenhouse or other plant-care positions.

Gary S. Schroeder, whose baccalaureate degree in human services was earned at Metropolitan State College, is vocational training coordinator of the Horticulture Training Center.

Sales as well as training

But vocational training is only one aspect of HTC operations. Under the direction of business manager Donald F. Ritterbusch, the greenhouse itself has become a viable member of the metro-Denver area's horticulture industry. The center now offers a continuing crop of indoor foliage plants and fresh carnations, and future plans include the rotation of bench crops in accordance with seasonal demands. (The growing of vegetables was recently discontinued in favor of higher-profit crops which also offer a better training medium.) Under contract, the center will grow bedding plants, groundcover landscape plants, and specialty crops, and though its emphasis is on wholesale selling, it encourages retail sales as well.

Seventeen additional acres are available at the HTC site for future expansion of greenhouse space and fieldcrop operations.

Visitors are welcome at the center, which is located not quite a mile south of Arapahoe Road at 7353 South Parker Road, Monday through Saturday, from 8:00 a.m. to 4:30 p.m. And additional information on center programs (training and sales) may be obtained by calling 693-3165.

Developmentally disabled workers in the HTC greenhouse — Two former trainees who are now employed by the center.

Illustration Sources

Front cover: Drawing by Frances Frakes Hansen
Page 35: Photograph by Bill & Berta Anderson
Pages 37, 39, 42: Drawings by Suzanne Ash
Page 44: Drawing by Doris Peacock
Pages 47, 49, 50: Drawings by Stephen Blecher
Pages 52, 53, 54, 55, 56: Drawings by Frederick W. Lenhart
Pages 58, 59, 60, 61, 62: Drawings by Panayoti Peter Callas
Page 64: Photographs by Sarah Erickson

The Green Thumb

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

NON-PROFIT ORG.
U. S. POSTAGE
PAID
Permit No. 205
Denver, Colorado

Do Not Fold

Address Correction
Requested

The Green Thumb

Autumn 1981 Vol.
Thirty-eight

Number Three

The Cover

Peony
Frances Frakes Hansen

The Green Thumb

Autumn 1981
Vol. Thirty-eight, Number Three

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use of the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2547.

The Green Thumb

Autumn 1981

Velma A. Richards
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Dedications: Four Promises Fulfilled

66 **Bernice Petersen**

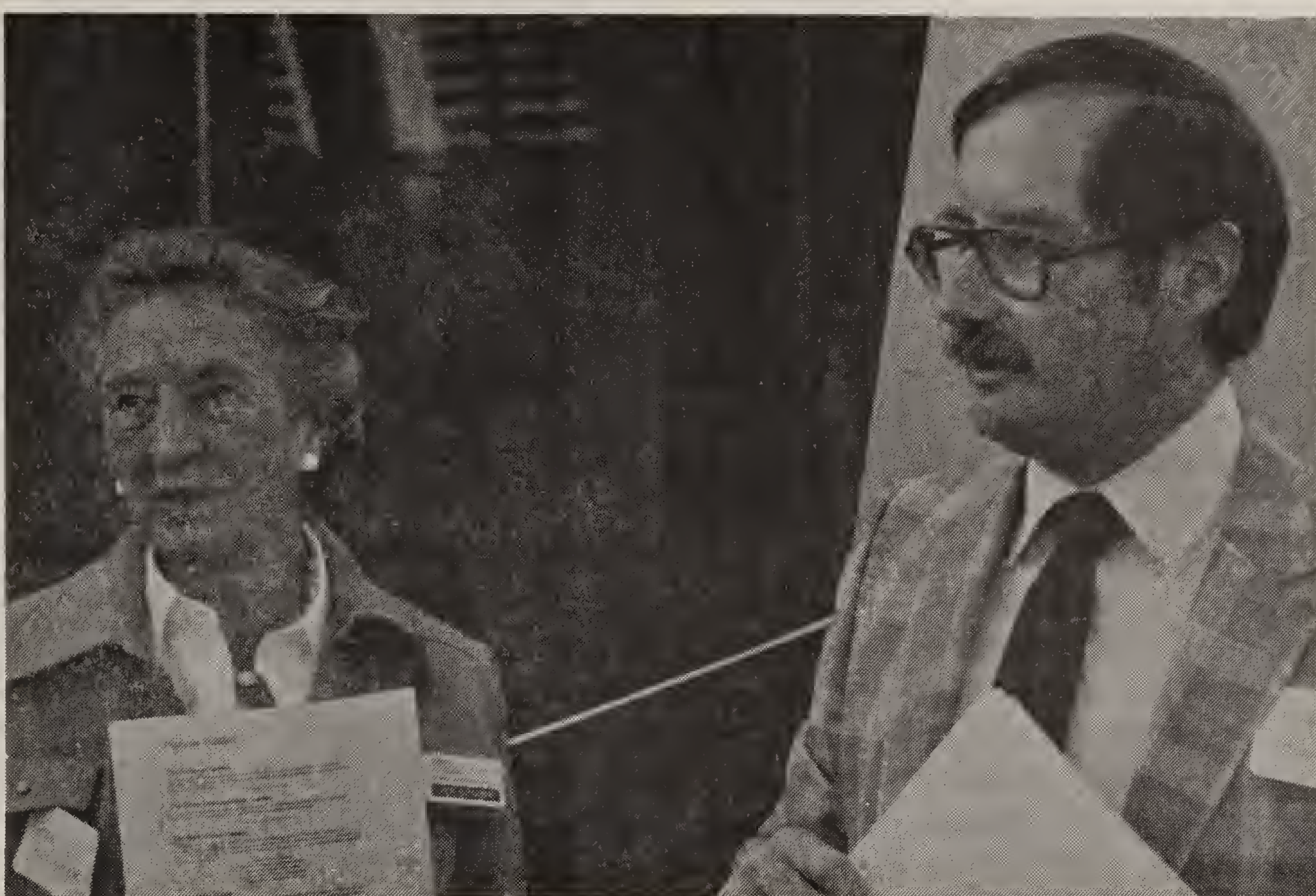
With the dedication of the Scripture Garden, the Home Demonstration Garden, Rock Alpine Garden and Alpine House on June 1, four magnificent promises were fulfilled — all integral components in the campaign to complete the master plan for Denver Botanic Gardens at 1005 York Street. Representatives of The Coors Foundation, Gates Foundation, Garden Club of Denver and Associates of Denver Botanic Gardens, as well as many individuals whose contributions made these achievements possible, were participants. Mayor William H. McNichols, Jr. accepted these "fulfilled promises" for the City and County of Denver.

The following evening, members of the Gardens were treated to special tours of the newly-opened areas plus the Margaret E. Honnen Orchid-Bromeliad Pavilion, dedicated last January but closed to visitors during the interim. On June 3 the public was invited to enjoy these gifts of gardens.

Bernice (Pete) Petersen has been a volunteer at the Gardens and its predecessor, Colorado Forestry and Horticulture Association, for 30 years. She is presently chairman of the Editorial Committee.

At the ribbon-cutting ceremonies Richard A. Kirk, President of Denver Botanic Gardens, noted how establishing a great botanical garden on the western high plains was one of the visions cherished by a small group of public-spirited citizens when Denver Botanic Gardens was incorporated in 1951 with Gladys Cheesman Evans as president. He also recognized Anna Reynolds Garrey, Ruth Porter Waring and Dr. Moras L. Shubert among the founders.

Richard A. Kirk, F. Charles Froelicher at Dedication Ceremony



Peggy Altvater and Merle Moore at the Alpine House

Merle M. Moore, Director of DBG, emphasized that with the construction and planting of the Rock Alpine Garden and Alpine House, situated in the southwest corner of the Gardens, members and visitors to our Gardens now have a unique opportunity to study and explore the world of plants from tropics to tundra at this botanical jewel mounted in an exquisite high plains setting. The original dream encompassed maintaining gardens where various tree, shrub and herb species may be tested or studied in various zones, from the typical eastern prairie zone to alpine timberlands. The zonal extremes of tropical plants as found in our Conservatory and the arctic tundra plants possible in the Rock Alpine Garden and Alpine House now make this possible at one location.

F. Charles Froelicher, Executive Director of the Gates Foundation, expressed genuine pleasure for the members of the Gates family — June Gates (Mrs. Charles C.) attended — who "join you today to celebrate the opening of this extraordinary Rock Alpine Garden . . . the final product far exceeds our expectations. The curator and the architect may rest assured that we view this project with pride and were pleased to be permitted to play a part. One of the goals of the Gates Foundation has been to improve the quality of life for those who live in Colorado. This garden will do exactly that for a century to come."

Mayor McNichols accepted and assisted Mr. Froelicher and Bernice Cannon (Mrs. Brown) in the ribbon-cutting ceremony.

Peggy Altvater (Mrs. F. V.) represented Associates of Denver Botanic Gardens, an organization of volunteers who support the Gardens both financially and physically. President during the time when most of the funds for the Alpine House were earned, she explained the Associates introduction to the southwest corner of the Gardens was during the early years of water shortage. A deep water well was essential to provide the sights and sounds for the spectacular waterways, and the little structure hidden behind the Alpine House houses "our water works." She continued, "Then a Rock Alpine Garden was included in the master plan and the building to be dedicated today was needed to house alpine plants too delicate to stand extremes of temperature and humidity, as well as some rare and endangered plants.

According to Panayoti Callas, curator of the garden: "Our summers may have hot weather but nights are invariably cool — a situation that places plants under far less stress than in muggy climates where they succumb to fungi and bacteria from extreme heat and humidity. Our winters are long, sunny and dry — a situation that suits alpines quite well. The wet winters along the two coasts of our continent are injurious to most alpines which are accustomed to a dry mantle of snow. As a result this garden can grow not only a broad variety of alpine and arctic plants but many montane, steppe and desert plants inconceivable in the wet climates where most institutional gardens exist. It is perhaps in this area — in the dryland plant materials — where this garden will achieve lasting importance."

Rock Alpine Garden a Reality

"We are proud to have a part in helping to develop what we believe is the finest garden of its kind in our country — perhaps even the whole world."

Thus, dreams for an outstanding rock garden with a dynamic collection of representative plants, both native and exotic, rich with colorful blossoms or a variety of foliage textures became reality. Herb Schaal, landscape architect of EDAW, carefully blended the five basic rock types one with another so that a maximum diversity of plants could be grown among them. Special soil mixes were prepared and are complemented by about 20-odd watering regimens to insure optimum cultural conditions.

The Rock Alpine Garden also reflects the cooperation that exists among Denver Botanic Gardens' supporters. The garden was a gift of the Gates Foundation, Marianne Kraft Memorial, Denver Botanic Gardens Guild, Cherry Point Garden Club, Mr. and Mrs. Bruce Alexander, and Mr. and Mrs. Theodore Wrenn. The Associates gave the Alpine House and furnish the stipend for the Curator. The rock wall that ties the house to the garden was sponsored by Denver Botanic Gardens Guild, coldframes were provided by Around the Seasons Club, hundreds of plants and cuttings were given by members of the Rocky Mountain Chapter of the American Rock Garden Society and most of the actual planting of more than 12,000 plants and unlimited hours of weeding were donated by many devoted volunteers.

Bea Taplin Presents Home Demonstration Garden

Bea Taplin (Mrs. T. E.), president of the Garden Club of Denver, assisted Mayor McNichols in cutting the ribbon at the Home Demonstration Garden. She commented: "The concept of a Home Demonstration Garden existed here a long time ago, and it seemed natural for the Garden Club of Denver to assume this project. As many of you know, some of our original members, for example, Mrs. Evans, Mrs. Garrey and Mrs. Waring, saw the need for a botanic garden of this scope in Denver, and they were foremost amongst those who had the foresight and devotion to bring this whole Denver Botanic Gardens to fruition.

"Two years ago when we started planning this project, we asked ourselves just what this Home Demonstration Garden should accomplish. We're a group of more than 50 ladies who are all gardeners. We're sometimes knowledgeable, almost always enthusiastic, and always opinionated, so this plan required a great deal of discussion. When we finally presented our landscape architect, Randy Randolph of Lifescape, Ltd., our pages and pages of plans, drawings, pictures and books, he gulped and said, 'work with 50 women?'

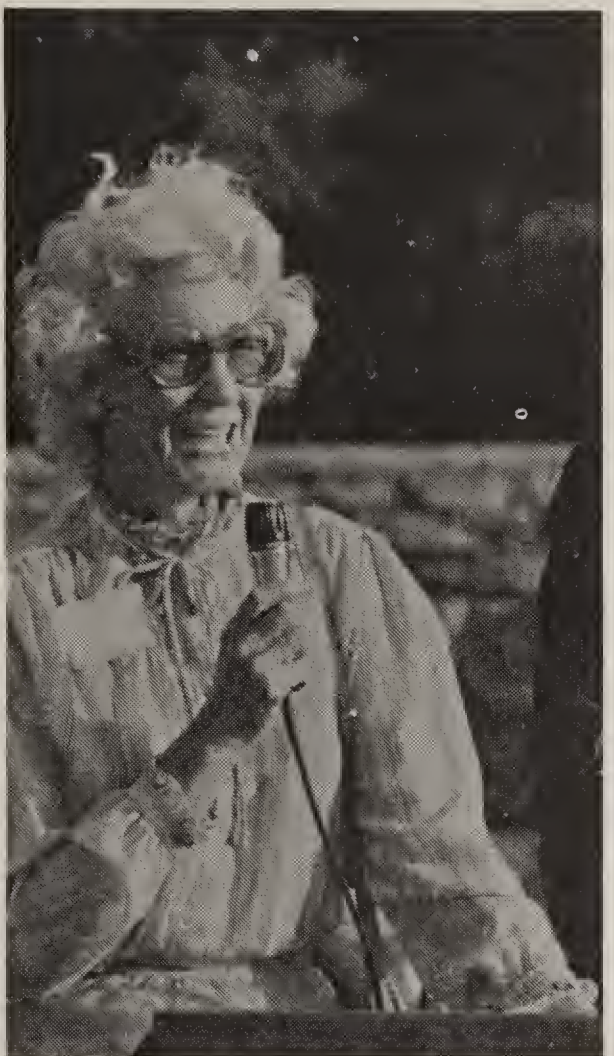
"We wanted to include examples of traditional and modern construction, areas exhibiting horticultural materials both old and new-to-Denver, all in consideration of low maintenance and water usage. We wanted a graceful pedestrian traffic pattern that would include a walk for the handicapped. In all, we wanted practicality *and* a gracious and charming garden. Randy Randolph incorporated our ideas, added his own and came up with this garden. Needless to say, besides his talent and capabilities, he has a keen sense of humor.

"It is with enormous pleasure that on behalf of the Garden Club of Denver I present this Home Demonstration Garden to Denver Botanic Gardens. We hope that you and the general public will enjoy this garden and learn as much from it as we did from putting it together."

In Mr. Moore's comments he pointed out the value of such a demonstration garden to our many visitors, stating: "Opportunities abound in this setting for the Botanic Gardens' visitor to carry away numerous ideas for the use of landscape building materials, garden design and plant materials suitable for the Denver area gardener. It is fitting that the Garden Club of Denver members have chosen this means of sharing their considerable talent and experiences in Rocky Mountain horticulture with those persons who come to the Botanic Gardens seeking new and innovative ideas."

Similar in form to the Conservatory, a striking lathhouse affords protection from summer sun. This demonstration garden features a recirculating pool providing the sound of trickling water, a terraced vegetable garden, a small aspen grove, and boasts a specimen of the double white flowering horsechestnut *Aesculus hippocastanum* L. 'Baumannii' and even a rose garden. Located on the south side of the Gardens it is adjacent to the Low Maintenance Demonstration Garden, developed by Lew Hammer many years ago. This garden, too, was recently renovated by the Garden Club of Denver.

Mayor William H. McNichols, Jr. Accepts Home Demonstration Garden for the City



Holly Coors at Scripture Garden

The Scripture Garden, culmination of an idea first proposed by Holly Coors (Mrs. Joseph), is an educational, ecumenical, living collection of plants described in religious writings, displayed in an architectural setting reminiscent of the Holy Land, Israel and adjacent areas.

Mrs. Coors, representing The Coors Foundation in its gift to the Gardens and to the City, told of her hopes for such a landscape at Denver Botanic Gardens and expressed pleasure with the impression of a Biblical Garden as planned by Jane Silverstein Ries (Mrs. H. F.), landscape architect who earlier had designed the Herb Garden extension which lies to the east of the Scripture Garden.

Mrs. Ries envisioned a hot, arid landscape heavy with stone, yet in stark contrast she saw lush green areas planted with papyrus and sedges and a walkway of compacted stone simulating the parched earth of the Holy Land.

Garden highlights are a round mosaic sculpture embellished with eight bronze medallions, symbols of the Christian and Jewish faiths, produced by William Joseph; a large black monzonite Praise Plaque contrasting with the buff stone wall which forms the backdrop for a bog garden; and the Tree of Judah, a redbud, planted in an appropriate setting. The garden includes an apricot which many believe was Adam's chosen fruit, pomegranate, Cedar of Lebanon, date palm and other exotic plants that will be moved indoors over winter. Groundcovers are lentils, faba beans, garlic, onion, chicory and true myrtle. Even dandelion is used in nontraditional yet aesthetically-pleasing ways, according to Gayle Weinstein, Botanist Horticulturist, who researched and selected the plants. Benches of native Lyons sandstone provide opportunities for rest and meditation.

Planning for the three-day celebration was carried out by Gloria Falkenberg (Mrs. John F.), Director of Development, Ellen Waterman (Mrs. L. A.), Chairperson of the Public Relations Committee and Peggy Patrick (Mrs. Norman), Chairperson of the Membership Subcommittee. They were assisted by numerous other committee members, volunteer guides and members of the Gardens' staff.

Autumn Color and Falling Leaves

Helen Marsh Zeiner

September is the month when our Colorado aspen reach their peak of golden glory, and soon many of us will be driving to the mountains to see this beautiful spectacle before the leaves drop and only bare branches remain etched against the sky.

Beautiful and impressive as autumn colors are, the actual fall of leaves from trees is also a spectacular phenomenon of the plant world. It is an interesting stage in the lives of trees and other plants living in regions with wide seasonal changes, such as wet and dry seasons, or hot summers and cold winters of the temperate regions. Plants lose great quantities of water through their leaves, but during the growing season this water is replaced by water absorbed through the roots. However in dry seasons or in periods of cold such as we have in our Colorado winters, the plant is not able to absorb water through the roots. The fall of leaves cuts down on the terrific water loss and the plant can withstand the period when there is little or no absorption — all an orderly part of nature's plan.

Helen Marsh Zeiner, Ph.D., a regular contributor to *The Green Thumb*, is a former professor of botany at the University of Denver and is Honorary Curator of the Kathryn Kalmbach Herbarium.

Long before there is any external evidence that the leaves are about to drop, there are changes going on within the leaf to prepare it for this time. At the base of the leaf stem (petiole) a layer of thin-walled cells arises. This layer of cells forms a weak place called the absciss layer where the petiole will break away from the twig. At the same time, a layer of corky cells develops between the thin-walled cells and the twig, so that when the leaf falls there is no open wound. Upon completion of the absciss layer, the leaf is held to the twig by the veins or strands of vascular tissue which extend through the absciss layer, and by the outer covering of cells, the epidermis. This is a very precarious support, and a strong gust of wind or rain will bring the leaves tumbling down. The corky layer of cells forms the "leaf scar" which is marked with tiny dots — the bundle scars — where the veins passed into the leaf. These occur in characteristic patterns upon the leaf scar, which in turn always has a characteristic shape, so that these features are commonly used in identifying trees in winter.

Some trees, such as oaks, have no well-developed absciss layer, and the leaves hang on long into the winter.

In the north temperate regions, the fall of leaves is often accompanied by gorgeous color changes. Many people believe these changes to be caused by frost, but this is not altogether true. Frost which happens to occur at the right time may help in the process, but often the colors appear and the leaves drop before there has been any frost at all.

Actually the leaves of trees pass through various stages of development and mature, much as fruit matures. Change in color and leaf fall are merely stages in the maturation of the leaf.

Coloration is due to chemical changes in the maturing leaf. During the summer, leaves are green due to the presence of the pigment chlorophyll in tiny bodies (plastids) in the cells. Also present are yellow pigments, which we do not ordinarily see in the summer because they are masked by the green chlorophyll. During the summer, chlorophyll which is destroyed is replaced. In the autumn, as the vital activities of the leaves are reduced, chlorophyll which is destroyed is no longer replaced and the yellow colors become evident.

The reds and purples are due to chemical substances (anthocyans) which are dissolved in the cell sap. These substances may be present in some leaves in varying amounts at all times, or as is more usual, only in spring or autumn. They are formed at times of low temperature when a large supply of sugar is present in the cell sap. During the summer when growth is active, sugars are used rapidly or transformed rapidly and do not accumulate in the leaf. In the autumn, they do tend to accumulate and the anthocyans develop. The degree of red or blue depends upon the acidity or alkalinity of the cell sap, and there is no end to the possible shades which might occur.

When the leaf is alive, the cell walls are normally light-colored and translucent. Upon death, they may become brownish. The various combinations of yellow, red, brown, and even black from some dead cells produce an infinite variety of color so that it is no wonder that we find many different colored leaves upon the same tree, or two trees of the same species side by side with quite different coloring. Perhaps the wonder is that two leaves are ever alike!

Reprinted by request from *The Green Thumb*, September 1967

Peonies

For Your Garden

74 **Harry B. Kuesel**

The beautiful peony, one of the loveliest of the late spring flowers, is so easy to grow and maintain in the high plains area. This excellent perennial, once established, requires little care and can give most satisfying performance for decades. It is really a long-lived flowering plant.

First let us consider establishing peonies in the garden, and then some of the history of species discovery and horticultural development of the multitude of varieties now available.

Autumn is the best time to plant peonies for the next year's bloom. For planting select a well-drained site with at least a half-day of full sun. Our local soils are generally just right if low spots where water can collect are avoided. When ready to plant the roots, dig a generous hole about 18 inches deep and 18 inches in diameter. One peony-grower advised, "Dig a $40 hole to plant a $4 plant."

Harry Kuesel has been a trustee for Denver Botanic Gardens since 1973. He was instrumental in establishing the peony display garden as well as the iris garden here. His articles have appeared in the national periodicals of these societies.

Remember the plant can grow there for the next 100 years!

It is desirable to put 3 to 6 inches of well-rotted manure in the bottom of the hole and cover with at least 3 inches of good garden soil. Next, hold the roots in place and fill in around them with soil to keep them spread in their natural position. Be careful to keep the buds (eyes) near the surface, because if they are planted too deeply it will take several years before the plant will bloom. After watering, if the soil settles so the buds are no more than 2 inches below the surface, sift garden soil or well decomposed compost loosely over them. Mulching with straw or peat is desirable for the first year or two, but once the plant is established this is seldom necessary.

Few diseases or pests bother peonies, but sometimes a fungus known as botrytis will attack. This can be controlled by spraying the tops after they have died down in autumn with a good fungicide like Bordeaux mixture or one of the newer synthetics such as benomyl or benlate. It might be wise to spray the buds and soil around them again when new growth starts in spring.

Peony season extends for several weeks with the earliest ones flowering in early May and others not until late June. Occasionally the tree peony lutea hybrids will also bloom in the fall.

Earliest Peonies

Historically an old double red, probably imported during Colonial days, was the only peony known to any extent in America up to the middle of the 19th century. This was the species, *Paeonia officinalis* L., a native in Europe. The generic name, *Paeonia,* comes from Greek mythology. Paeon, the mythical physician, was said to have cured the wounds of Pluto, god of the underworld. This made Aesculapius, teacher of Paeon, so jealous he planned to have Paeon killed. Pluto, however, gratefully thwarted his plot by changing Paeon into this flower which forever after bore his name.

'Spellbinder' — A Single Form

Native to Siberia and North China, *Paeonia albiflora* Pall., really accounts for the peony's increased popularity. During the middle of the 17th century the Dutch East India Company sent an ambassador to China and reports from the embassy described Chinese peonies in glowing terms. Not until 1805 was the first *P. albiflora* imported to England by Sir Joseph Banks, president of the Royal Horticultural Society. By that time these Chinese peonies had also been imported into Japan and greatly improved. William Prince, an American nurseryman, imported some peonies to Flushing, Long Island, shortly after they reached England and by 1824 he listed over 40 varieties in his catalogue.

The only species native to North America is *Paeonia brownii* Doug. which grows in California. It is tender in cold climates and somewhat of a botanical curiosity. The Chinese recognized two species long ago: *P. albiflora,* a perennial with herbaceous habit; and *P. moutans* Sims. (*P. suffruiticosa* Haw. in Bailey, *Manual of Cultivated Plants*), a woody-stemmed type called "tree peony." Actually the latter is more of a shrub in ultimate form.

Basic Flower Forms

The four basic flower forms which have been identified by the American Peony Society are described as follows:

SINGLE: Five or more petals arranged around the center of seed-bearing carpels and pollen-bearing stamens.

JAPANESE: Five or more petals surrounding abortive stamens, most of which produce no pollen and many sterile stamens, called staminodes. These may actually look somewhat petal-like. This type is sometimes described as "anemone flowered." In the Japanese type the carpels may be normal, hence they are possible seed producers when viable pollen is applied.

SEMI-DOUBLE: Five or more outer guard petals surround a center of broad petals, many of which may have pollen-bearing anthers. These stamens may be arranged in rings or appear in the center of all the petals. The carpels may be normal, or transformed into petals, in whole or in part.

DOUBLE: Five or more guard petals with often no trace of stamens or carpels which have been nearly or completely transformed into "petaloides," small petals. There are at least two sub-types: the "bomb" type with the guard petals shorter than the center ones, giving a globular shape; and the "rose" type, full double, with all petals large and forming a rather flat face.

'Charlie's White' — A Double Anemone Form

Interest in peonies in this country through the first quarter of this century centered on garden cultivars selected from natural insect-pollinated crosses. Seedlings from such natural hybrids produced varying results and the most attractive forms were named and vegetatively propogated. *Paeonia albiflora* was the primary source of all such varieties. There was little hand-crossing between the various named varieties and still less hybridization between distinct species. Victor Lemoine in France and Peter Barr in England developed some early species hybrids, but these were not widely grown in the United States.

New Hybrids

About the time of World War I three members of the American Peony Society, without knowing of each other's work, began hybridizing *Paeonia officinalis* with *P. albiflora*. These three were Edward Auten, Jr., of Princeville, Illinois, Lyman Glasscock of Elmwood, Illinois, and Professor A. P. Saunders of Clinton, New York. These men later inspired fewer than a dozen others to make these same crosses. Mr. Auten introduced some 250 varieties of Chinese peonies and about 50 hybrids between the two above-named species over a period of 40 years. In his opinion his finest Chinese varieties were 'Auten's Pride,' 'Mary Auten,' 'Carolina Moon,' 'Nippon Brilliant,' and 'White Delight.' Some of his famous hybrids are 'Auten's Red,' 'Chocolate Soldier,' 'John Harvard' and 'Veritas.'

Mr. Glasscock, during a 35-year period, produced about a dozen Chinese varieties and 50 hybrids. He is most famous for a dark red "bomb" variety called 'Red Charm.' Other fine varieties he developed are 'Golden Glow,' 'Flame,' 'May Delight,' 'Sunbright.' 'Bright Knight,' 'Mahogany,' 'Gay Cavalier' and 'Black Monarch.' These are all hybrids between the two species just named. In addition, by crossing *P. officinalis* with *Paeonia tenuifolia* L. he produced another hybrid named 'Laddie' which has a very distinctive narrow fern-like foliage and bright cup-shaped single flowers. All of Auten's and Glasscock's hybrids were of various shades of red, mostly ranging from medium to dark but of very clear colors.

New Colors

Professor Saunders was not content to cross only these three species, but set out to hybridize as many different species as he could obtain. He named and introduced over 50 hybrids. While *Paeonia albiflora* served as a parent for more than 80 percent of his introductions, he used several different varieties of *P. officinalis*. A dark crimson form of the latter was used to develop his 'Challenger' strain which created a sensation at the American Peony Show in Boston in 1928. 'Challenger,' 'Buccaneer,' 'Defender,' 'Liberator' and 'Mariner' are some of the better-known cultivars. Perhaps his most famous cross was

between *P. officinalis* 'Lobata' (by Perry) and *P. albiflora* which yielded colors of scarlet, cerise, cherry, salmon, vivid pink, coral and flamingo — colors heretofore unknown in peonies. Among the most famous of these cultivars are 'Alexander Woollcott,' 'Carina,' 'Red Red Rose,' 'Heritage' and 'Your Majesty' in pure reds and 'Claudia,' 'Constance Spry,' 'Cythers,' 'Laura Magnuson,' 'Lovely Rose' and 'Ludovica' in pink shades. Another species, *Paeonia decora* G. Anders., a dark red-violet color, and its white form, *P. decora* var. *alba,* were crossed on *P. albiflora,* and this resulted in 'Reward,' a dark red single, and 'Camellia,' a lovely double white rosette with a pale peach tint.

Paeonia macrophylla Stern, a large-leaved species, was imported from the Caucasus Mountains in Asia Minor. This dwarf plant has small cup-shaped white flowers and large coarse leaves. It imparts a strong early blooming tendency to its offspring and thus extends the normal flowering by two to three weeks. The most famous Saunders' offspring from crossing this species with *P. albiflora* is 'Chalice,' an immense shimmering white single. By self-pollinating 'Chalice,' he developed a second generation hybrid named 'Archangel,' equally fine. Then he back-crossed with the *P. albiflora* parent to produce 'Garden Peace,' a distinctive white with bright red stems, and 'Requiem,' a white single with soft leathery texture.

Another species from the Caucasus is *Paeonia whittmaniana* Stev. This is more tender, but Professor Saunders was successful in getting hybrids with *P. albiflora* and *P. whittmaniana*. 'Ballerina,' a creamy white is perhaps best known. *Paeonia emodii* Wall, a tall plant with many nodding small white flowers and fernlike foliage, was imported from the Himalayan Mountains via an English botanical garden. When it was crossed with *P. albiflora*, a most unusual five-foot tall white single resulted and was named 'White Innocence.' Its white flowers have greenish centers and there are several flowers to each swaying stem.

Two other Asiatic species, *Paeonia beresowski* Stern and *Paeonia veitchii* Lynch, crossed with *P. emodii* gave Saunders two similar strains which he called 'Early Windflower' and 'Late Windflower' because they bloom ten days apart. Both of them have white anemone-like flowers which nod gracefully above fernlike foliage. *Paeonia mlokosewitschii* Lomak. is another species native to the Caucasus region. It is early-flowering, light clear yellow with unusual light gray-green foliage. Saunders tried for several years to make a cross of this species with *P. albiflora* without success. But Dr. Earle B. White made this cross over 500 times and finally got one hybrid seed. Miraculously the seed was viable and its seedling lived and bloomed with pale ivory-yellow single flowers and foliage midway between its two parents. It was named 'Claire de Lune.' Saunders was successful, however, in crossing *P. mlokosewitschii* with *P. tenuifolia*. This latter species is native to the Crimea and Caucasus regions and has single bright crimson flowers and fernlike foliage. Also there are two variants (mutations) of this species one of which is pink and the other double. The best

'Haru No Akebono' Japanese Tree Peony

Saunders obtained from this cross was named 'Gwenda,' a tea-rose-colored single. He then created triple hybrid crosses by mating 'Gwenda' and its siblings with *P. albiflora*. 'Rosellette,' a tall very early single pink, and 'Rushlight,' a single pale ivory-yellow are two fine results. Carrying this line further, he made what might be called quadruple crosses by combining these triple hybrids with *P. macrophylla*. Two of my favorites from this are 'Firelight,' a very early single rose-pink, and 'Starlight,' a pale yellow single.

Professor Saunders also did extensive work with hybridizing tree peonies. The tree peony, *Paeonia moutan*, is native to northwestern China. *P. suffruiticosa* from another part of China is quite similar and is, in fact, considered by some botanists to be the same as *P. moutans*. The flowers are very large, white with purple markings at the base of the petals or all purple. The Japanese imported this species from China over a thousand years ago and developed it in size and color range from pure white to red to purple and many shades in between. Professor Saunders imported, again through botanical gardens, a single-flowered yellow tree peony species that originated in Tibet called *Paeonia lutea* Delaz. ex Franch. He crossed this with *P. moutan* and its related forms from Japan. The results were spectacular. He got single yellows with and without crimson flares; semi-double and full-double yellows, ruffled and furled; single and double suffused and tinted with rose; single and double reds and single to double dark crimson, maroon with black markings; and finally, ivories and pearled shades suffused with mauve.

In recent years Louis Smirnow, a peony enthusiast, returned to China to investigate a report from a Chinese gardener that the old Chinese dynasties never allowed their prized tree peonies to be exported and that there existed blue and green shades of peonies, descendants from ancient Chinese gardens. He successfully brought to his nursery on Long Island three shades of blue and two greens in the lighter tints.

Denver Botanic Gardens now has good specimens of most of these different types of peonies. Included are about 2 dozen hybrids and Japanese and Saunders "lutea" tree varieties — divisions from those in my garden at Littleton. From the Klehm estate in Arlington Heights, Illinois, 19 patented peonies representing some of the best *Paeonia albiflora* varieties were obtained. Gilbert H. Wild and Son of Sarcoxie, Missouri, generously donated 66 more herbaceous varieties.

For anyone who would like to include peonies in his own garden, a visit to Denver Botanic Gardens to see the peonies blooming should be very worthwhile. With its extensive selection, the peony garden presents a beautiful sight in late spring.

References

American Peony Society Quarterly Bulletins. 1904-1980

Boyd, James, Ed. 1928. *Peonies, Manual of the American Peony Society.*

Harding, Mrs. Edward. 1917. *The Book of Peony.* New York: J. P. Lippincott.

Kessinich, Greta M., Ed. 1976. *A History of the Peonies and Their Originations.* American Peony Society.

Kessinich, Greta M., Ed. 1979. *The American Society — The Best of 75 Years.* American Peony Society

Stern, Sir Frederick C. 1946. *A Study of the Genus Paeonia.* London: Royal Horticultural Society.

Seabound Bermuda — Dogwood Enchantment

Josephine Robertson

The spring tour of Denver Botanic Gardens, April 21 to May 2, offered a happy combination of almost a week in Bermuda and the remaining days in the Philadelphia area at the height of the dogwood season. It was a delightful trip, although with some problems in Bermuda for our leaders, Jim Holme and Andrew Pierce.

Before they were settled, the Bermuda Islands, 600 miles off the coast of North Carolina, were famous for their tropic richness, their stormy waters and the many shipwrecks on the coral reefs. Shakespeare, knowing of the adventures of Sir George Somers, one of whose ships was wrecked there in 1609 on the way to Virginia, chose just such an island for the scene of "The Tempest." The play begins with Prospero ordering up an extra fierce storm and while it rages he speaks with Ariel of "the still vexed Bermuthes."

Josephine Robertson has contributed several articles for *The Green Thumb* in her 14-year association with Denver Botanic Gardens. Her special interest in garden history and that of her late husband, Campbell Robertson, in trees have taken them to many interesting botanical gardens and arboretums around the world.

The "Bermuthes" were still vexed while we were there, not from tempests but from economic unrest leading to a strike which spread from buses to taxis, ferries, garbage collectors, postal and telephone service and finally to hotel employees. Due to the ingenuity of our leaders, although our schedule did not follow the expected order, we enjoyed all the points of interest, using taxis when the buses struck, a boat when the taxis struck and private cars belonging to the hotel management to take us through the Bermuda Industrial Union picket lines to the airport — just in time — as that was the day the hotel workers went out.

We stayed at the comfortable Palmetto Bay Hotel enjoying the salt sea breezes and charming gardens. Under the informed leadership of Andrew Pierce, who was welcomed everywhere by old friends, we were given a thorough introduction to the flora of Bermuda.

When first discovered, the islands were clothed with rich forests of cedar (*Juniperus bermudiana* L.). The wood was excellent for building houses, ships and furniture, but in the 1940's a devastating scale attacked the cedar

and today it is impossible to find any but a few scrawny diseased specimens. However, the wood, which took a rich polish, is handsome in old doors, rafters and furniture. Another loss was the Easter lily crop which flourished for many years but fell prey to a virus introduced by some bulbs from Japan. One still sees them in garden borders but not in masses.

Although the land area of the islands is only about the size of Manhattan, with property scarce and valuable, we heard familiar arguments for the preservation of nature reserves and open space. In Colorado we hear of open space acquisitions of hundreds, even thousands of acres; but, during our visit, we read in the paper an announcement of the ceremonies with which the National Trust's Open Space Committee, headed by David Wingate, accepted with gratitude the gift of three quarters of an acre valuable for containing palmetto and sedge endemic to the island.

We spent a fascinating evening listening to a slide talk by David Wingate, a long time conservationist with a special interest in birdlife, who has fought to preserve natural habitats. He gave a cliff-hanging account of how he has managed to preserve a few of the cahows, large shore birds that once swarmed over the islands. They were decimated when early inhabitants turned to them for food and their young were the prey of the long tailed tropicbird. Some years ago efforts to protect them looked promising but then came a decade of drifting DDT from the mainland which almost destroyed them. Finally, with the ban on the use of DDT, and with the conservationists building ingenious nesting places with entrances too small for the tropicbirds, the cahows are beginning to breed again.

Only 17 of Bermuda's plants are considered endemic, that is, native only to the islands. A few of these are the ill-fated cedar, palmetto (*Sabal bermudana* Bailey), blue eyed grass (*Sisyrinchium bermudiana* L.), Bermuda maidenhair fern (*Adiantum bellum* Gilbert), various other ferns, sedges and mosses. Back in time beyond reckoning many of today's "native" plants must have reached the limestone and coral islands as seeds washed up by the sea or dropped by birds. Bermuda has been hospitable to introductions. There is color everywhere with a British tradition of formal gardening.

This is the oldest British colony with an elected house of assembly. Because of no income tax affluent residents are attracted, but the main industry is tourism. A few horse drawn carriages remain but cars (no rentals) are permitted and the traditional bicycles seem to have been overtaken by alarming swarms of mopeds. The clean pastel colored houses with white limestone roofs that guide rainwater into cisterns, towns that have no high-rises, well preserved historic areas and tempting shops hold strong appeal for visitors from smoggy cities.

We had a delightful morning at the Bermuda Botanical Gardens, where Andrew Pierce served on the staff before coming to Denver. These gardens, under assorted names and auspices, have been flourishing for almost a century. Today they are maintained through the Department of Agriculture and Fisheries, with Dr. Walwyn Hughes as director.

A Spreading Banyan

Among the features are the palm and hibiscus gardens, the plumaria collection, many cacti and succulents, the exotic house and fern collection. Most impressive were the spreading banyans. Because there is no fresh water on the island, rain must do it all for people and plants, but with an average of 50 inches a year this is not a problem. (How nice not to have to water!)

Unfortunately the Agricultural Exhibition, a great event in the gardening world, was cancelled because of the strike. We enjoyed visits to glamorous private estates, two boat trips and a visit to the Maritime Museum which displays relics of many ancient shipwrecks.

After six full and informative days, we flew to Philadelphia to luxuriate in the old Bellevue Stratford. Free now of strike problems, for the next four days we cruised by bus through the enchanting Pennsylvania countryside at the height of the dogwood and azalea season. Special tours were arranged in the Chestnut Hills area to the Fred and Ernesta Ballard gardens, which were small, formal and remarkable for the collection of bonsai, and to the gardens of the Frederick Pecks who live in a home of native stone dating back to 1815. Mr. Peck is an artist and landscape architect and their interesting garden includes a charming studio and swimming pool. We then visited the Liddon Pennock nursery. Mr. Pennock, for many years head of the prestigious Pennsylvania Horticultural Society, took us through his beautiful house and series of compartmented gardens with statuary, pools and gazebos. The last stop was at Andalusia where we toured the house built in the early 1800's by financier Nicholas Biddle with its sweeping lawns leading down to the broad Delaware River.

Topiary Garden

The highlights of the Philadelphia days were the visits to Winterthur, former home of Henry Francis DuPont, and Longwood Gardens created by Pierre S. DuPont. The mansion at Winterthur is a mecca for antique lovers with its priceless furnishings of old and rare treasures with emphasis on Americana. The wooded grounds at this time of year are a fairyland of pink and white dogwood with stately tulip trees towering above and a carpet of trillium and spring flowers underneath flanked by great drifts of azaleas and many other flowering shrubs. The color combinations are so artfully designed that wherever one looks the scene is like a watercolor painting. In Andrew Pierce's words this is a "flow garden" with winding paths leading from one scene to another. The azalea walk

reveals many cultivars and species.

Longwood Gardens, by contrast, have a formal elegance, not quite like Hampton Court or Versailles, but an American adaptation of grandeur. There is a great feeling of space in these 350 acres. The different displays and styles of gardening are well separated by walks, hedges and lawn. A spectacular fountain area faces the conservatory. There are rose, rock, wisteria, topiary and Italian water gardens, plus such natural features as wildflower meadows, rhododendron and forest walks. One could spend many days here, but time must be allowed for the four acres of conservatory where orchids, acacias, camellias, roses, cacti and hibiscuses flourish, with open spaces adorned by pools used for ever-changing seasonal displays. Everything is tended beautifully as Mr. DuPont left a generous endowment. What other conservatory can boast a pipe organ and ballroom?

In both Longwood and Winterthur one is impressed by the beauty of the towering trees: tulip, oak, beech, Kentucky coffee, linden and many others that grow so much taller and more luxuriantly than those transplanted to our high plains area. To be sure they have had a head start. Mr. DuPont purchased the land for Longwood Gardens from the Peirce family whose ancestors received it as a landgrant from William Penn. In the early 1800's two Peirce brothers began planting specimen trees, some of which still stand majestically today.

Our farewell dinner was held at the Dickens Inn, a delightful old restaurant in the heart of Philadelphia's refurbished Society Hill area. There were many other memorable features of this spring tour but perhaps these impressions will give some idea of our doings. We enjoyed pleasant accommodations, delicious food and, best of all, the pleasures of traveling in a congenial group.

Rock Garden at Longwood

Dr. Harrington, A Premier Botanist

Berta Anderson

Early this year Colorado lost one of its most noted and most loved botanists. Harold David Harrington, Professor Emeritus of Botany and Plant Pathology at Colorado State University, died of a heart attack January 22, 1981. Through his writings and his teaching he made his mark upon hundreds, professionals and amateurs alike. To his students he was friend as well as instructor and imbued them with his own thirst for the knowledge and understanding of plants. He is spoken of as a kind and gentle man, full of humor. His interests went beyond plant life to music, poetry, athletics, and "who-dunits."

Dr. Harrington first came to Colorado in 1936 to teach taxonomy at Colorado State University, but after three years returned to Chicago where he taught botany and zoology at Chicago Teacher's College. In 1943 he was recalled to Colorado State to undertake the compilation of the *Manual of the Plants of Colorado* under the auspices of the Colorado State Board of Agriculture and Colorado A. & M. College. The first edition was in 1954 with a second printing in 1964. This monumental work, which took 10 years of research and study, has proven invaluable to anyone interested in Colorado flora. It covers 2,794 species and 351 subspecies. Dr. Richard T.

Berta Anderson, co-editor of *The Green Thumb* for five years, is the author of *Wild Flower Name Tales*, a book of biographical sketches of early botanists for whom many plants are named.

Ward, former head of the Botany Department at C.S.U., said of the work: ". . . . what probably has provided the greatest benefit to the most people . . . . a book used each year by a large number of undergraduates, a book important to the amateur botanist, vital to forest, range, and wildlife managers, and indispensable to the ecologist and taxonomist, the *Manual* remains the major treatment for the southern Rockies and the adjacent plains."

His writings include many books, pamphlets and scientific articles. At the Best Western Books of 1967 show, Dr. Harrington's *Edible Native Plants of the Rocky Mountains* was selected as one of the top 25 books printed during that year. It was acclaimed as a beautiful book as well as one full of interest. Edibility of the plants listed was checked by Dr. Harrington and his wife in preparation for its publication. It was followed in 1972 by *Western Edible Wild Plants*. Both books were illustrated by a former student, Yoshiharu Matsumura, who became professor of biology and natural sciences at Shoei Junior College in Japan. Dr. Harrington's last work was *How to Identify Grasses and Grasslike Plants (Sedges and Rushes)*, 1977.

Harold David Harrington was born in DeMotte, Indiana, March 11, 1903, one of eight children born to Charles and Elizabeth Harrington. In 1909 the family moved from Indiana to Mitchell, South Dakota, and in 1911 to Graettinger, Iowa. His father was a carpenter except for a few years spent in farming. It was the years on the farm that aroused Harold's interest in plant life.

He and an older brother, Elbert, enrolled at the University of Northern Iowa where they alternated their time — one would work for a year supporting the other in undergraduate school. They both were involved in athletics and music while in school. For relaxation Harold read and wrote poetry and read mystery stories. He taught himself to play the violin, the Spanish guitar, and the ukelele and earned money during the summers by playing for dances.

After two years of college he was called back to his home town high school for a year to teach various subjects and coach football and basketball.

After receiving his B.A. degree at the University of Northern Iowa in 1927, he continued his studies to receive the degree Master of Science in 1928. While completing work for the degree Doctor of Philosophy in 1933, he taught part time in the Iowa City High School, and later full time there until he came to Fort Collins in 1936. Dr. Harrington taught at Colorado State University, except for his brief teaching experience at Chicago Teacher's College, until he retired as Professor Emeritus in 1968.

In 1933 Dr. Harrington married Edith Jirsa, a fellow botanist. She was of invaluable assistance to him in plant collecting, photography, and in the preparation of his publications. In addition, she worked as a seed analyst at the Colorado State University Seed Laboratory.

They loved to travel. They spent four months touring in Europe, visiting all the important

herbariums and botanical gardens, covering 15 countries by automobile, botanizing and photographing the flora. These pictures were later shared in many talks to garden clubs and nature groups in the Rocky Mountain area. The couple also visited Canada, Mexico, Baja California and every state in the continental United States. Early in 1980 they toured the Pacific — Tahiti, Bora Bora, New Zealand, Australia, Fiji and Hawaii. After their return home, they spent many summer days in their beloved Rocky Mountains.

Largely through the efforts of Dr. Harrington, the herbarium at Colorado State University became a major plant collection. He added his collections of 28 years and those of many former students to the original herbarium. It is now one of the principal reference herbariums for the region, both for native and non-native plants.

Nationally, Dr. Harrington was respected as a scholar and botanical authority. His former students carry with them his great love and appreciation of nature. Letters written to him and about him at the time of his retirement in 1968 included such appreciative phrases as "true scholar and humanitarian . . . . modest, unassuming, gentle, kindly . . . . a generous and sensitive man . . . . a serious scholar and a humorist as well . . . . the name of H. D. Harrington belongs on that roster to whom the academic respectability of C.S.U. truly may be attributed."

He was awarded in 1977 a lifetime honorary membership in the Colorado Native Plant Society. He was also a member of the Colorado-Wyoming Academy of Science, and the honor societies, Sigma Xi and Gamma Sigma Delta.

Coloradans interested in the world of plants are fortunate to have his many writings to perpetuate his knowledge and insight.

Carolus Linnaeus, the father of modern botany, wrote in 1737:

> "We should not seem to have bestowed too valuable a gift in offering to such men [those who had made botanical discoveries or otherwise contributed to the knowledge of the science] the name of a plant: nevertheless they win more honor, to wit, EVERLASTING REMEMBRANCE, through our guileless science than if they set up statues or temples or founded castles or cities."

Dr. Harrington's "Everlasting Remembrance" is *Penstemon harringtonii* Penland, named for him by Charles William Penland, professor of botany at Colorado College at Colorado Springs. It is endemic to an area near Green Mountain Reservoir in Summit County, Colorado. Tall, with large true blue flowers, it has two protruding stamens which distinguish it from other penstemons. Also, a species of *Oenothera* may be named for him. Such a project takes some time to complete, as the plant has to be researched carefully to be sure that it has not been given some other name previously.

Penstemon harringtonii,
An Everlasting Remembrance

References

Anderson, Berta. 1976. *Wild Flower Name Tales*, Colorado Springs, Colorado, Century 1 Press.

Linneaus, Carolus. 1737. *Critica Botanica*, translated from the Swedish by Sir Arthur Hort, revised by Miss M. L. Green, botanist, Royal Botanic Gardens, 1938, Kew. Printed in London by the Ray Society.

Harrington, Mrs. Edith. 1981. Personal interview, reinforced by personal notes and newspaper clippings.

Focus On *Vanilla planifolia* in the Boettcher Memorial Conservatory

Peg Hayward

Orchidaceae, an enormous family of plants many of whose members are a delight to man's eye, also includes the vanilla of commerce. *Vanilla planifolia* Andr. (*V. fragrans* Ames) is a climbing, tropical epiphytic orchid native to Mexico and Central America.

Vanilla first attracted the attention of the western world in 1520 when the Spanish conquistadores observed the Mexican Emperor Montezuma drinking chocolate which was flavored with ground vanilla pods. Appreciating the flavor of this drink, the Spanish took vanilla back to Europe. At first cultivation of the vanilla orchid in alien countries was a failure because the plants would not set fruit. The reason for this was established when it was discovered that the flowers in Mexico were fertilized by certain species of bees and hummingbirds unknown in other parts of the world. The problem was solved in 1816 when Charles Morren, a Belgian botanist, introduced hand pollination. This is still practiced today, especially in Madagascar and the Seychelles which produce most of the world's natural supply.

The climbing stems of vanilla form an interesting pattern with alternate obliquely descending fleshy leaves with an aerial root opposite the base of each. The leaves are up to 9 inches long and 2 inches wide. Unlike most orchids of this spectacular plant family, its clustered flowers are so inconspicuously greenish-yellow that they can be overlooked by a passing person. Each flower has its tubular labellum backed by two more petals and three sepals. Its single stamen is joined to the style inside. A bloom lasts for only a day but the flowering period extends for two months so each vine may have as many as a thousand blooms. The number of flowers which are pollinated and allowed to produce mature fruits depends upon the vigor of the plant. Uusually, on vigorous plants, 8 to 10 flowers on 10 to 20 inflorescences are pollinated, of which 4 to 8 capsules are allowed to grow to maturity on each raceme.

Peg Hayward has long been associated with the Boettcher Memorial Conservatory and initiated its Tour Guide program. "Focus On" appears regularly in *The Green Thumb*. Her husband Phil Hayward, a well-known professional artist, is illustrator.

A great amount of skilled hand labor goes into the curing, grading and packing of vanilla fruits, known as vanilla "beans" because of their shape. The procedure is an ancient one dating back to the 16th century. Modern methods show only a few refinements. The freshly picked unripe beans are stored in sheds for a few days until they begin to shrivel. Then they are spread out on blankets in the morning sun for a few hours to warm up and dry slightly. Afterward they are "sweated" in the shade under thick blankets. Before nightfall, they are put into airtight boxes to protect them from chill and dampness. This process is continued for two weeks or more until the beans turn a dark chocolate brown color. During the treatment, an enzyme secreted by hairlike papillae within the narrow confines of the capsule spreads through the fermenting cells of the wall and acts on a glucoside converting it into vanillin, a crystalline substance responsible for the aroma of vanilla. The beans are conditioned in closed bins to develop the full aroma. The whole process takes five to six months.

There is no doubt that vanilla was domesticated in Mexico, or at least in Central America, but when and by whom remains a mystery. The techniques involved in growing and processing it are too complicated for it to have been ancient in cultivation. Today, vanillin can be synthesized cheaply but it cannot match the real extract of vanilla beans.

A vanilla orchid may be observed in the Boettcher Memorial Conservatory collection.

Vanilla planifolia

References

Bailey, L.H., 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

Brouk, B., 1975. *Plants Consumed by Man.* New York: Academic Press.

Hyams, Edward, 1971. *Plants in the Service of Man: 10,000 Years of Domestication.* Philadelphia and New York: J. B. Lippincott Company.

Purseglove, J. W., 1972. *Tropical Crops Monocotyledons 2.* New York: John Wiley & Sons, Inc.

China — A Sentimental Journey

T. Paul Maslin

One autumn day in 1979 my wife brought me a magazine and said, "Look at this." It was an advertisement by a travel agency of a tour in China. What was so exciting about the tour was that it included a visit to Lushan where my wife and I had taught in the Kuling American School and where I had spent the greater part of my childhood and adolescence. It also included Wuhan where I was born and where my wife and I had met while we were teaching at the Boone Middle School and the Central China University. Best of all, a cruise through the Yangtse River Gorges was included, a trip we had made together in December 1935. We couldn't have planned a nicer itinerary, so with no more ado we made reservations for the sentimental journey.

The tour started in Hong Kong on August 12, 1980. From there we went by train to Guangzhou (Canton) then after a sumptuous dinner flew to Shanghai. The following day touring began in earnest. I had hoped to have an opportunity now and then to do a little seed collecting between prescribed tour events, but it turned out that diversions of that sort were too difficult in schedules involving groups that had to move and stay together. It was also very frustrating to find a desirable plant in flower but without mature fruit.

In Shanghai we visited a large and extremely popular garden built in 1557 by a city official named Yu. The Yu Yuan (Yuan means garden) was our first experience with genuine Chinese gardens. We had read extensively about them and knew what to expect, but seeing and reading are two different things. Chinese gardens consist of four basic elements: buildings, water, trees and shrubs, and most important of all, eroded limestone rocks. To western eyes the rock work seems over done and occasionally too contrived. But in some gardens, where more restraint was employed, the rock arrangements are aesthetically pleasing and fascinating. Flowering plants are used but not to create masses of color or compositions involving rocks, interesting foliage, and contrasting colors as we do. Other features are frequently used in Chinese gardens, too, such as bridges of many sorts, interestingly paved walks, potted and trained shrubs, lattice-work, and shaped windows and entrance ways. A Chinese garden is certainly a place for a westerner to collect seeds of unusual alpine plants.

Dr. T. Paul Maslin is Professor Emeritus of the University of Colorado Museum where he was curator of the zoological collection for 26 years. His first article in *The Green Thumb* appeared in 1948.

From Shanghai we went to Suzhou, the garden city of China, also referred to as the Venice of China because of its fascinating network of canals. Here we visited first outstanding gardens, all different and yet all remarkably similar. These gardens too were extremely popular. It was here that we saw some of the finest examples of the vertically placed columns of grotesquely eroded rocks from Tai Lake. One of the most famous of these is the 20 foot high "Cloud-capped Peak", a magnificent and beautifully shaped mass of limestone. One of the principal evergreens used extensively in all of the gardens we saw is the Lace Barked pine, *Pinus bungeana* Zucc. This pine tends to be bush-like and to develop multiple leaders when young. This is taken advantage of by the Chinese to encourage the trees to produce laterals and inhibit excessive vertical growth. The result is an irregularly shaped tree somewhat contorted to assume the weathered forms found on precipitous cliffs and in mountains so loved by Chinese painters. Many of the more spreading trees were braced by beams or ropes reminding us of the carefully supported pines in Japanese gardens. It was only later that we learned that most of these supports and ropes were hastily placed to protect the trees from high winds. Indeed, there was a typhoon warning for the area. Fortunately for us the typhoon never developed into more than a light rain storm.

Suzhou Pavilion

Pinus bungeana is not a popular tree in the United States. It is extremely slow in getting started, and in its middle years it tends to be vertically compressed. But the exfoliating bark, like that of the sycamores, is interesting and beautiful. Only mature trees develop a splendor found in few pines. The crown ultimately spreads out and the lower laced bark effect is replaced by rough chalk white bark. The tree is a native of north China and Mongolia and should do well in Colorado. A specimen in our garden is growing vigorously, but after 15 years is still poplar-like and little more than 20 feet tall.

Nanjing

From Suzhou we went on to Nanjing and here visited all the main tourist attractions such as the impressive Yangtse River Bridge, the Jiangsu Provincial Museum, the Sun Yatsen Mausoleum, the Lingyu Temple Park, the Zijin (Purple Mountain) Observatory, the Yuanwu Lake in People's Park, and other points of interest. The fir trees bordering the approaches to the Sun Yatsen Memorial are very beautiful. We were told that they are the Tibetan fir, probably *Abies spectabilis* (D. Don) G. Don. Our guides also referred to them as the "Christmas Trees", presumably because of their pyramidal shape. In the beautiful forests at the Lingyu Park two bulbs were in full bloom, the very showy spider lily, *Lycoris radiata* (L. Her.) Herb. and the dull lilac flowered *Scilla chinensis* Benth. The latter is much taller than the ones I have and I am beginning to believe mine are nothing more than the *S. autumnalis* L. I collected a handful of bulbs of *L. radiata* at the Provincial Museum where they had been uncovered and abandoned when the local gardeners had re-formed some beds.

Our drive up through the deciduous forests on the way up to the Purple Mountain Observatory had me fidgeting in my seat, so many interesting shrubs and trees rushed by with glimpses of unknown plants beneath. The only seeds I could get were from a small locust-like tree, probably an acacia, from what we were told was a "Carnelian Tree" because of its red carnelian berries. Identification must wait until the Denver Botanic Gardens can raise plants to a recognizable size.

Lushan

Lushan, where I had been raised, is a mountain mass lying west of Poyang Lake and south of the Yangtse. It is a 5,000 foot isolated outspur of the south China Hills. Due to its height it traps a tremendous amount of water, over 200 inches a year, and for this reason is lush with an immense variety of plants. It has been popular for thousands of years and is studded with temples, pagodas, waterfalls, and magnificent views. A botanical garden established here in 1934 was well worth the visit. It specializes in gymnosperms and has a large collection. They also have a well

tended and labelled general garden of shrubs and perennials and a good rock garden. The director was extremely cordial and provided me, for the Denver Botanic Gardens, with a very well prepared seed list. An exchange relationship is now established. Not much was in flower when we were there but the more open areas were spangled with *Platycodon grandiflorus* (Jacq.) A.D.C., what I took to be *Lilium speciosum* Thunb., and a very showy and gracefully arching *Lespedeza,* probably *sieboldii* Miq. I particularly wanted seeds of this, but none had formed at that time (Sept. 2). I was able to collect some shoots of a small vertical sedum hoping that it was the one a friend has asked me to look out for. These were wrapped in plastic until we reached our ship, the Kun Lun. From then on the poor plants suffered repeated alternations of plastic entombment in the dark of my pockets to brief moments of light in some hotel drinking glass. Their worst experience was in the New World Hotel in Hong Kong. Here I placed the shoots in an ashtray braced with wet paper. They enjoyed the pale light of our window for two days, but the third day, when we returned from a shopping tour, they were gone! After a frantic search for maids, I located a chief floor steward who spoke excellent English. He discovered that our maid had emptied and cleaned the ash trays. Fortunately the waste bin from that floor had not been carried off. So its contents were dumped onto a sheet; and a small gang of stewards, maids, and I pawed through the refuse of a hundred rooms. And sure enough, at the very bottom we found the bedraggled shoots and rescued them. They had just better be the white-flowered sedum my friend wants!

Sedum chaneti
The White-flowered Sedum

Wuhan

At Wuhan, my birthplace, we visited the splendid Wuhan University. On its grounds we found a planting of the Wu T'ung tree, *Firmiana simplex* (L.) W. F. Wight, shading one of the walks. This tree is in Sterculiaceae which also includes the genus *Cola,* members of which provide flavor to some well-known soft drinks. The Wu T'ung tree is mentioned frequently in Chinese literature, credited with magical qualities of one sort or another. Its large seeds are used in the production of moon cakes eaten at the autumn festival of the eighth month, and it is the only tree upon which the celestial bird, the phoenix, will

alight. The tree is also of horticultural interest. It grows rapidly, has a smooth green bark and huge maple-like leaves supported on 1 foot petioles. One of the unique features of the tree is its fruit. The

flowers are not showy but carpels grow precociously before the fruit matures into Chinese spoon-like structures about 3½ inches long, on the edges of which the pea-like seeds ultimately form. Its habitat is south China, but a friend of mine reports that he has seen groves of it in Beijing (Peking). That city is on the 40th parallel, so we can assume that if the tree is happy there, it should thrive here. I recovered a nice lot of seed from the "spoons" beneath these trees and time will tell whether they can accommodate themselves to our climate.

Another tree was in fruit at this time, a tree previously used extensively as a shade tree for city plantings. So far I have not been able to identify this tree; the foreign community of China when I was there called it the "Mountain Ash." It definitely is not a *Sorbus,* but it might be some variety of *Fraxinus,* the true ashes. The flowers and ultimately the one-winged seeds are closely attached to a pendent 5 inch stem and are produced in vast quantities. The compound leaves are pinnate, like our own ashes, but the tree as a whole spreads more and makes a very good shade tree. This species is now replaced in China by millions of *Platanus* (Sycamores) planted along every major street, a conspicuous sylvan cultural feature of the Peoples Republic of China.

The next part of our tour took us up the Yangtse River Gorges to Chongqing (Chungking). Even this far from the coast, palm trees with fan-shaped leaves were common and on the open slopes of the less gorge-like areas citrus orchards were abundant. We stopped at three small towns on our way up and I was able to collect a few spore bearing fern fronds. Whether these will produce hardy ferns remains to be seen. From here on the tour was condensed and we had little time to do more than follow the leader.

Guangzhou Orchid Gardens

A final visit in Guangzhou (Canton) to the Orchid Gardens was a great pleasure. Here in this subtropical area bamboos are used extensively in gardening where they make wonderful stands in glades and along walks. Their beautiful stalks of various colors bend gracefully, providing living lattices to peer through at distant vistas. Little use was made here of grotesque limestone, and buildings, while present, were not important elements. Water, walks for strolling, pergolas, and small gazebos were featured. This garden, while still basically Chinese, shared enough with our western ideas of gardens to make it more acceptable and aesthetically pleasing to us, and provided an easy transition back to our own gardens at home.

Denver Botanic Gardens, Inc.
A Non-Profit Organization

Illustration Sources

Front cover: Drawing by Frances Frakes Hansen
Pages 66, 67, 69, 70, 71: Photographs by David L. Warren
Pages 73, 80: Drawings by Frances Frakes Hansen
Page 75: Photograph courtesy of W. G. Sindt
Page 76: Photograph courtesy of Roy Klehm
Page 79: Photograph courtesy of American Peony Society
Pages 82, 83, 84, 85: Photographs by Josephine Robertson
Page 86: Photograph courtesy of Mrs. Edith Harrington
Pages 89, 95: Drawings by Janet Wingate
Page 91: Drawing by Phil Hayward
Page 93: Photograph by T. Paul Maslin

The Green Thumb
Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Do Not Fold

The Green Thumb

Winter 1981 Vol. Thirty-eight

Number Four

The Cover
Scripture Garden Sculpture
Frances Frakes Hansen

The Green Thumb
Winter 1981
Vol. Thirty-eight, Number Four

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2548.

The Cover:
Centered in the scripture garden is a terrazo mosaic with eight bronze sculptural medallions: four Christian symbols — the Lamb, the Grape Vine, the Wheat and the fish; and four Jewish symbols — the Menorah, the Burning Bush, the Torah and the Ram's Horn. The center of the relief contains the Christian Cross and the Jewish Star of David. The Denver Botanic Gardens scripture garden committee commissioned William Joseph to produce this sculpture which he modeled and cast in lost wax at the foundry at Loretto Heights College where he is professor of art.

The Green Thumb

Winter 1981

Velma A. Richards
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

The Chatfield Arboretum Visitor Center

Kathleen Hoeft

In 1886, the one-room Deer Creek School was built along Deer Creek in rural Jefferson County. Now, in its present location about a mile up the creek from its original site, this quaint building is being restored to serve as the Chatfield Arboretum Visitor Center.

As originally built, the schoolhouse consisted of a large classroom with an entry vestibule. The front porch was added later. The building was heated by a coal burning stove in early years and later by an oil stove. There was no indoor plumbing, and water had to be carried in from a well. A barn which no longer exists was located nearby to provide shelter for the horses that some of the students rode to school. Only one teacher taught grades one through eight, with an enrollment of up to 25 students. In later years, a music teacher came once a week from Denver.

After the school closed in 1950, the building was converted to a house. Walls were added, and the single classroom was divided into a livingroom, kitchen, bathroom and two bedrooms. The ceiling was lowered and sheetrock covered the original plaster walls. When these walls and finishes were removed, evidence of the classroom wiring for four ceiling lights remained, and the painted-on-blackboards were still on the walls. Nailers in rough plaster on the lower portions of walls indicated a wainscot.

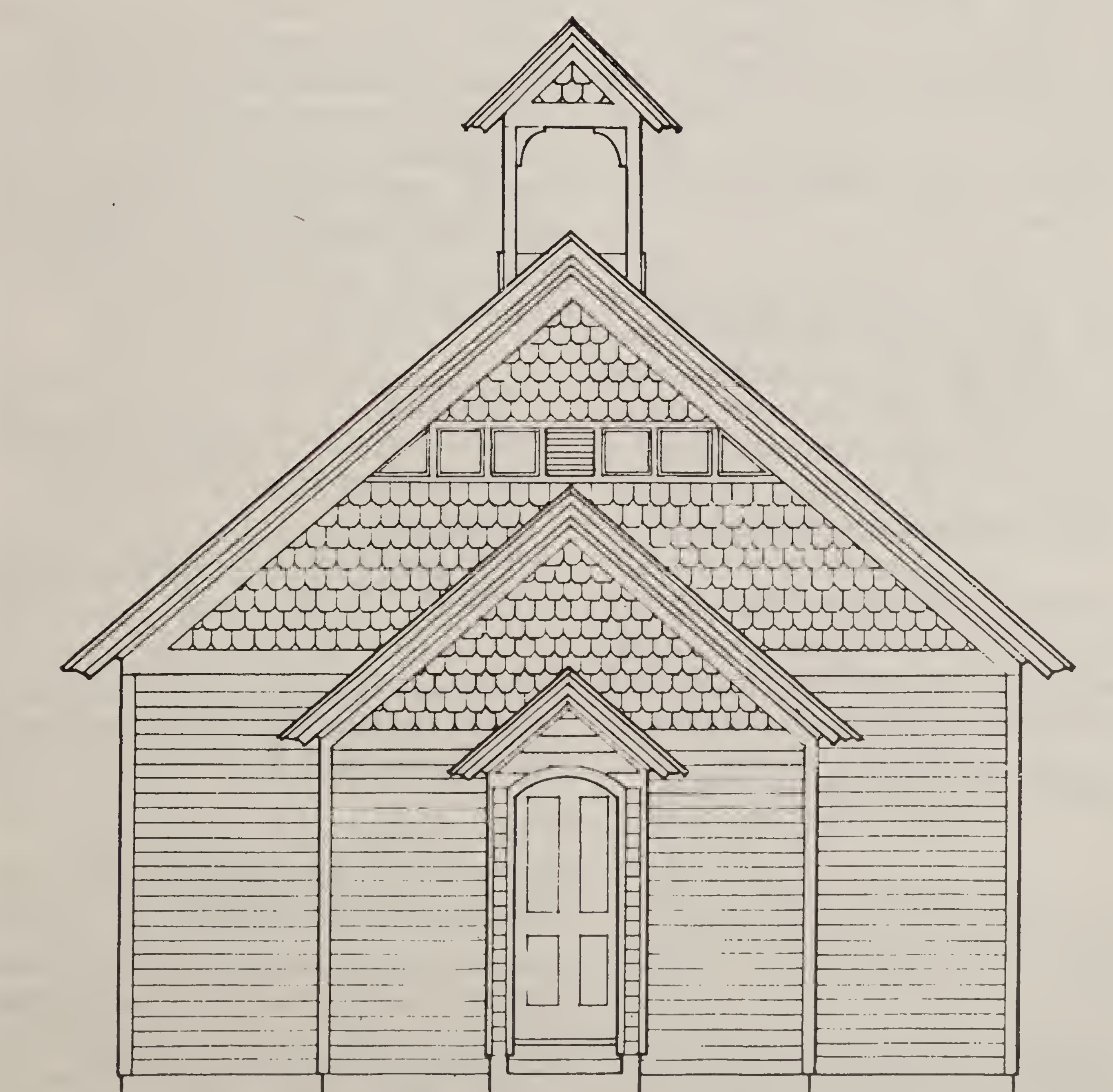
In adapting the building as a visitor center, it is being restored to its original state as a schoolhouse. The classroom had lost its wainscoting when the building was converted to a residence (although wainscoting remained in the vestibule), and this is being reinstalled. Some of the windows had been altered — one made into a door, another into a smaller window — and two windows had been added. The newer windows have since been removed and all the original ones returned to their initial configuration.

Kathleen Hoeft, of Long-Hoeft Architects, has done restoration work on many historic buildings in Denver including many houses in Curtis Park, the Molly Brown House, and the Denver Botanic Gardens House at 909 York Street.

Enough evidence remained to determine historic paint schemes. As it was when it was a school, the wainscot, trim and doors inside the building will be painted dark green and the walls and ceiling of the vestibule light green. Although the walls and ceiling of the classroom would have matched those in the vestibule,. for its use as a visitor center an off-white with a green tint was chosen. In deference to its new use, baseboard heat and additional electrical outlets have been added.

Aside from the windows, a few layers of white paint and the addition of the front porch, the exterior had few changes. Outside walls were painted medium tone gray with dark gray trim. Window sash and the chimney were dark red. The roof's wood shingles were stained dark gray and the playground equipment was red.

Like other country schools, the Deer Creek School not only educated the young, but served the community as a social and cultural center. It is an appropriate place for the visitor center of Chatfield Arboretum.



Restored Schoolhouse to Become Visitor Center

The Scripture Garden
within the
Denver Botanic Gardens

Gayle Weinstein

The era of Biblical times is familiar to millions of people and no other literature has had greater influence on mankind than the Holy Scriptures.

In June, 1981, within the confines of 650 square feet, a space symbolically designed to link modern age with the beginning of western civilization was dedicated as the Scripture Garden. The Garden was initiated by Mrs. Joseph Coors and funded by the Coors Foundation.

In this carefully planned space designed by Jane Silverstein Ries, contrast and diversity become apparent. While one travels imaginatively back through time to the Holy Land, a span of more than 3,000 years unfolds.

The sandstone wall and raised planting beds, stone benches, and the hard packed surfaced pathways as well as the lush vegetation are all reminders of the geographic diversity of the Holy Land.

> "For the land which you are entering to inherit is not like the land of Egypt from which you have come . . . But the land which you are entering to inherit is a land of hills and valleys, watered by the rains of heaven." (Deuteronomy 11:10-11)

Centered in the Scripture Garden is the artistic work of William Joseph, a bronze and mosaic sculpture of alternating symbolisms, characteristic of the Jewish and Christian faiths. In the southwest corner is another focal point, a monzonite prayer stone with the inscription:

> "O Lord
> How manifold are thy works!
> In wisdom hast thou made them all;
> The earth is full of thy riches."
> (Psalm 104:24)

Selection of plant material displayed in the garden was based on several factors:

What species are most representative of the Biblical age and what are these species?

Are the species that existed over 3,000 years ago still in existence?

What can be grown here?

Which species will be most meaningful to the visiting public?

Gayle Weinstein, a Botanist-Horticulturist at the Denver Botanic Gardens, with a committee researched and selected the plants for the Scripture Garden.

A Garden within the Gardens

The first two questions are the most difficult to answer. There are many translations and interpretations of the Scriptures, often conflicting. For example, what is the *tree of knowledge*?

> ". . . But of the *tree of knowledge* of good and evil, thou shalt not eat of it. . ."
> (Genesis 2:17)

> "And when the woman saw that the tree was good for food, and that it was pleasant to the eyes, and a tree to be desired to make one wise, she took of the fruit thereof, and did eat. . ."
> (Genesis 3:6)

From the Scriptures the tree is described as a shade tree with fruit of a golden color. However, the apple, as translated in many Biblical versions, has never been found wild in the Holy Land and it is believed to be an introduced species. Most botanists consider the *tree of knowledge* to be the apricot.

Because of different interpretations and because the writers were not botanically trained, many plants were identified according to the region in which the author was living. For example, is the *lily* an anemone, a hyacinth or a lily?

> "Consider the *lilies* of the field, how they grow. . ."
> (Matthew 6:28-30)

And what is the *rose* of Sharon — a tulip, a daffodil or a rose?

> "I am the *rose* of Sharon and the lily of the valleys."
> (Song of Solomon 2:1)

These problems plus the land changes, both natural and man-caused, that occurred through the ages obscure a complete understanding of what actually grew there.

> "Thou art a great people . . . thou shalt not have one lot only; but the hill-country shall be thine; for though it is a forest, thou shalt cut it down . . ." (Joshua 17:17)

> "Therefore, because of you, (Mount) Zion shall be plowed as a field; . . ." (Micah 3:12)

While many passages pertaining to plant identification are confusing, others are clear.

> "For the Lord your God is bringing you into a good land, a land of streams, of springs and underground waters flowing out in valleys and hills, a land of wheat and barley, of vines and fig trees and pomegranates, a land of olive trees and honey . . ." (Deuteronomy 8:7-10)

What can be grown here in Denver? To answer this third question an understanding of the topography and climate of both areas is essential. Over 3000 years ago the Holy Land was a part of a fertile crescent-shaped space — an area that transcended the political boundaries of today. This region would now be composed of Israel, Jordan and a small part of Egypt. It consists of three major plant zones — the Mediterranean, the steppe, and the desert and oases. The Mediterranean region is characterized by dry, mild summers and wet winters with an average rainfall of 20 to 40 inches per year. Mediterranean and desert areas are separated by the steppe region which receives less than 14 inches of annual rainfall. Receiving less than 8 inches of annual rainfall, the desert is interspersed with oases of tropical vegetation. These oases are fed by underground springs.

Climate in the Colorado area is as similarly diverse as is that of the Holy Land. Biological clocks may be different; e.g. flowers blooming here in May will bloom there in October. Growing much of the plant material here does not present a major problem. Many species can and are becoming permanent plantings. Those that cannot endure are overwintered in the greenhouses.

Examples of plant materials being used in the Scripture Garden representative of these zones are:

Mediterranean Zone — Cedar of Lebanon (*Cedrus libani* A. Rich.)

> "See now, I dwell in the house of *cedar*. . ." (II Samuel 7:2)

and Hyacinth (*Hyacinthus orientalis* L.)

> "I am a saffron of the plain, a *hyacinth* of the valleys." (Song of Solomon 2:1-2)

Steppe — Wormwood (*Artemisia judaica* Lour.)

> ". . . lest there should be among you a root that beareth gall and *wormwood*." (Deuteronomy 29:18)

Oases — The Date Palm (*Phoenix dactylifera* L.)

> "The righteous shall flourish like a *palm* tree . . . They shal bring forth in old age . . ." (Psalms 92:12-14)

To the final question — Which species is the most meaningful? — the answer is surely an individual one. Perhaps one of these is particularly significant to you.

Salvia judaica Boiss., a member of the mint family whose branched flower reflects the design of the Menorah.

> "And he made the candlestick of pure gold: . . . his shaft and his branch, his bowls, his knops, and his flowers, were the same; . . . And six branches going out of the sides thereof . . ." (Exodus 37:17-18)

Salvia judaica

Olea europaea L. The olive was one of the most valuable trees of the ancient Hebrews and was well known to both the rich and the poor.

> "And the dove came in to him in the morning; and, lo, in her mouth was an olive leaf pluckt off . . ." (Genesis 8:11)
> "These are the two olive trees . . ." (Revelation 11:4)

Myrtus communis L. The myrtle with its sweet smelling leaves and fragrant flowers is referred to as a symbol of divine generosity.

> "Instead of the thorn shall come up the fir tree, and instead of the brier shall come up the myrtle tree." (Isaiah 55:13)

The Scripture Garden, like the Holy Land, is a small space encompassing many worlds. History, philosophy, and contrasting forces coalesce. The Scripture Garden is an awareness of the unbroken unity of all people.

References

Alon, Azaria, 1978. *The Natural History of the Land of the Bible.* New York: Doubleday and Company.

Anderson, David A. 1979. *All the Trees and Woody Plants of the Bible.* U.S.A.: Word Books.

Hareuveni, Nogah. 1980. *Nature in Our Biblical Heritage.* Israel: Neot Kedumium Ltd.

Moldenke, Harold and A. Moldenke. 1952. *Plants of the Bible.* Massachusetts: Chronica Botanica Company.

The Holy Scriptures. 1973. Masoretic Text. U.S.A.: The Menorah Press, Jewish Publications of America.

The Holy Bible. Authorized King James Version, Goodspeed or Chicago Version, and other Christian versions.

A Select List of Shrubs

Low to Medium Shrubs Generally Below 6 Feet

E. Alan Rollinger
Bernice E. Petersen

		BLOOM		FRUIT		GOOD AUTUMN COLOR	GOOD WINTER EFFECT	TOLERATES DROUGHT
		COLOR	SEASON	COLOR	SEASON			
Amorpha canescens	*Leadplant	V	Au					X
Amorpha nana	*Dwarf Indigo	V	Au					X
Aronia melanocarpa	Chokeberry	W	Ma	B	Se	X		
Artemisia abrotanum	Southernwood							
A. cana	*Thread Sage						X	X
A. tridentata	*Black Sage						X	X
Atriplex canescens	*Saltbush, Chamiso			W	Se		X	X
Berberis koreana	Korean Barberry	Y	Ma	R	Se	X	X	X
B. mentorensis	Mentor Barberry	Y	Ma	P		X	X	
B. thunbergii	Japanese Barberry	Y	Ma	R	Se	X	X	
B. thunbergii 'Atropurpurea'	Red Barberry	Y	Ma	R	Se	X	X	
Caragana pygmaea	Pygmy Siberian Pea	Y	Ap					X
Caryopteris incana	Blue Mist Spirea and var. 'Heavenly Blue'	Bl	Au				X	
Chaenomeles, spp.	Quince, Texas Scarlet and others	R	Ap-Ma	Gr-Y	Se	X		
Chamaebatiaria millefolium	*Fernbush	W	Su					X
Chrysothamnus spp.	*Rabbitbrush — blue or green foliage	Y	Se			X		X
Cornus serica 'Kelseyi'	Kelsey's Dwarf Dogwood					X	X	
Cotoneaster adpressa	Creeping Cotoneaster	P	Ma	R	Se	X	X	

Alan Rollinger, a professional landscape designer, teaches Plant Materials and Planting Design at Colorado State University. He assisted George Kelly in the booklet "Good Gardens with Less Water."

Bernice E. Petersen, Honorary Editor of *The Green Thumb*, has written many articles for it. She is also a knowledgeable home gardener.

		BLOOM		FRUIT		GOOD AUTUMN COLOR	GOOD WINTER EFFECT	TOLERATES DROUGHT
		COLOR	SEASON	COLOR	SEASON			
C. apiculata	Cranberry Cotoneaster	P	Ma	R	Se	X	X	
C. dammeri 'Skogsholmen'	Bearberry Cotoneaster	W	Ma			X	X	
C. divaricata	Spreading Cotoneaster	P	Ma	R	Se	X	X	
C. horizontalis	Rock Cotoneaster	P	Ma	R	Se	X	X	
C. integerrima	European Cotoneaster	P	Ma	R	Se	X	X	
Cytisus x praecox	Scotch Broom	Y	Ma				X	
Euonymus alatus 'Compactus'	Dwarf Burningbush					X		
E. kiautschovicus 'Manhattan'	Spreading Euonymus						X	
Fallugia paradoxa	*Apache Plume	W	Su	W-P	Su	X		X
Holodiscus dumosus	*Rock Spirea	W	Ju					X
Hydrangea arborescens 'Grandiflora'	Annabelle Hydrangea (protected)	W-G	Jl-Se			X		
Hypericum kalmianum	St. Johnswort	Y	Su					
H. patulum 'Hidcote'	Hidcote Hypericum	Y	Ju					
Ilex x meserveae 'Blue Princess' 'Blue Prince'	Holly (protected) (need both to fruit)					X	X	
Ligustrum vulgare 'Lodense'	Lodense Privet					X	X	
Lonicera x xylosteoides 'Clavey's Dwarf'	Clavey's Dwarf Honeysuckle	W						
Mahonia aquifolium 'Compacta'	Compact Oregongrape	Y	Ma	Bl	Se	X	X	
M. repens	*Creeping Oregongrape	Y	Ap	Bl	Se	X	X	X
Nandina domestica	Heavenly Bamboo	W	Su	R	Se	X	X	
Opuntia imbricata	*Tree Cactus	P	Ma	Y	Au	X	X	X
Perovskia atriplicifolia	Russian Sage	Bl	SE					X
Philadelphus x *lemoinei*	Mock-Orange 'Glacier'	W	Je					

		BLOOM		FRUIT		GOOD AUTUMN COLOR	GOOD WINTER EFFECT	TOLERATES DROUGHT
		COLOR	SEASON	COLOR	SEASON			
	Dwarf 'Minnesota Snowflake'	W	Je					
	'Galahad'	W	Je					
Physocarpus opulifolius	Dwarf Ninebark							
'Nana'		W	Ma			X	X	X
'Dart's Gold'		W	Ma				X	
Potentilla fruticosa	*Bush Cinquefoil	Y	Su					
	Many cultivars	W						
Prunus besseyi	*Western Sandcherry	W	Ma-Je	Bl	Au			X
P. glandulosa	Pink or White	P	Ap					
	Flowering Almond	W	Ap					
P. triloba	Dwarf Flowering Plum	P	Ap-Ma					
Pyracantha coccinea	Firethorn							
'Pauciflora'		W	Ma	O	Se	X	X	
'Walker's Dwarf'		W	Ma	O	Se	X	X	
Rhodotypos scandens	Jetbead	W	Ma	B	Se			
Rhus glabra cismontana	*Rocky Mountain Sumac	Y	Ma			X		X
R. trilobata	*Threeleaf Sumac	Y	Ap			X		X
Ribes alpinum	Alpine Currant	G-Y		R				
R. aureum	*Golden Currant	Y	Ma	B	Se	X		X
Rosa cvs.	Floribunda Roses, many varieties	var.	Su					
Shrub roses, various	The Fairy Seafoam and others	var.	Su	R	Su	X	X	X
Old Garden Roses	Many varieties	var.	Su	R	Su	X	X	X
Rubus deliciosus	*Thimbleberry	W	Ma	B	Je			X
Salix purpurea	Blue Fountain Willow	Gr	Ap					
Shepherdia canadensis	*Russet Buffaloberry	Y	Ma	R	Je			X
Sorbaria sorbifolia	Ural False Spirea (suckers)	W	Je					X
Spirea x bumalda 'Froebeli'	Frobel Spirea	P	Je-Jl.					

		BLOOM		FRUIT		GOOD AUTUMN COLOR	GOOD WINTER EFFECT	TOLERATES DROUGHT
		COLOR	SEASON	COLOR	SEASON			
S. nipponica	Snowmound Spirea	W	Ma					
S. riegers	Dwarf Spirea	W	Ma					
S. trilobata	Threelobe Spirea	W	Ma					
Symphoricarpos albus	*Snowberry	P	Ma	W	Au	X	X	X
S. x chenaulti	Chenault Coralberry	P		P-R	Se	X	X	
'Hancock'	Hancock Coralberry			P-R	Se	X		
Syringa meyeri	Korean Dwarf Lilac	V	Ma					
S. patula 'Miss Kim'	Dwarf Lilac	V	Ma			*X*		
Viburnum carlesii	Korean Spice Viburnum	W-P	Ma			X		
V. opulus 'Nanum'	Dwarf Cranberrybush					*X*		
V. trilobum 'Compacta'	Compact American Cranberrybush	W	Ma	R	Au	X	X	
Weigela florida	Weigela	W-R	Je					
Yucca baccata	*Indian Banana	W	Je	G Br	Se	X	X	X
Y. filamentosa	Adam's Needle	W	Je	Br	Se	X	X	X
Y. glauca	*Soapweed	W	Je	Br	Se		X	X

Key:*-Native, B-black, Bl-blue, Br-brown, G-green, Gr-Gray, O-orange, P-pink, R-red, V-violet, W-white, Y-yellow; Mr-March, Ap-April, Ma-May, Je-June, Jl-July, Au-August, Se-September, Su-Summer.

Editor's Note: This chart is an adaptation of one more general in scope published in *The Green Thumb* in March 1952, Vol. 9 No. 3, when George W. Kelly was editor. It has been updated by E. Alan Rollinger and Bernice E.Petersen. George and Sue Kelly and Larry Watson were also consulted. Shrubs listed here are commercially available and generally hardy in the Denver area and in other parts of the state of similar altitude and climate. Tender ones are so noted. Tall Shrubs, generally 6 ft. and above were considered in *The Green Thumb,* Spring 1980, Vol. 37, No. 1.

References

Kelly, George W. 1979. *Shrubs for the Rocky Mountains.* Cortez, Colorado: Rocky Mountain Horticultural Publishing Co., Inc.

Pesman, M. Walter. 1975. *Meet the Natives.* Denver: Denver Botanic Gardens.

Landscaping for Energy Conservation

Lloyd Walker

Most homeowners invest in some landscaping for their home to improve its value and appearance. They should also consider the functional use of landscaping to reduce the amount of energy used in the home. Through proper use of trees, shrubs, vines, and manmade structures, the climate around a home can be modified to reduce heat gains in summer and heat losses in winter. Reductions in energy use are brought about by protection from winter wind and shading from summer sunlight. Using these techniques, winter heating bills may be reduced as much as 25% and summer cooling bills reduced 50% or more.

Heat Exchange Processes

Heat exchange in a home occurs through three major processes: air infiltration, heat conduction, and transmission of radiant energy through windows.

The first process, air infiltration, is the passage of outside air through cracks around windows and doors or other openings in house walls or ceilings. One of the ways outside air is forced through these openings is through pressure differences caused by the force of the wind on the outside of the structures. Surfaces of the home facing the wind will experience increased air pressure with increased wind velocity and air will enter the home through openings in these surfaces. Passage of air into the home will force an equal amount of interior air out of the home through openings in surfaces facing away from the wind. In winter, losses due to air infiltration may represent up to one-half the total heat losses on the windiest, coldest days. Properly placed landscape vegetation can reduce air infiltration by reducing wind velocity in the vicinity of the home.

The second process of heat exchange is conduction through materials from which the home is constructed. The amount of heat conduction through exterior surfaces is dependent on the insulating property of the building materials, thickness of material, surface area available for heat flow, and the temperature difference between the inner and outer surfaces of the home. Control of the temperature difference by proper landscaping can reduce heat conduction. The outer surface temperature is controlled mainly by the outside air temperature, the wind velocity and solar

Lloyd Walker is Extension Agricultural Engineer in the Department of Agricultural Engineering at Colorado State University, Fort Collins, Colorado.

radiation. In the summer, landscape vegetation can reduce the amount of solar radiation reaching the outer surfaces of a home and thus reduce heat conduction into the house. In the winter, solar heating of the building's exterior surfaces oriented to the sun can be beneficial in reducing the rate of heat loss by raising the outer surface temperatures of walls. Blocking cold winter winds from striking the home will also reduce conductive heat loss.

The third process for heat exchange in a home is transmission of solar radiation through windows. Large expanses of east or west facing glass will admit undesirable solar radiation in the summer. Large expanses of south facing glass will passively solar heat a home in winter. Vegetation around a home can regulate radiation transmission into a home as desired in different seasons of the year.

Landscaping for Energy Flow Control

The goal of landscaping for energy conservation is to regulate energy flows from the sun and the wind. The sun plays a very important role in the Colorado climate because of its abundance. Landscaping can regulate the amount of sun that reaches the home so that beneficial use can be made of solar radiation during the winter for solar heating, and unwanted solar radiation in the summer is blocked. Because of the Colorado summer climate of low humidity and cool nights, proper house design and proper attention to landscaping can reduce or eliminate the need for air conditioning. Summer shade is best provided by strategically located vegetation along the sunny borders of the home. Shade should be provided for south facing roof and wall surfaces which receive the most direct sunlight during midday when the sun is higher in the sky. Walls facing generally to the east or west should also be protected since these surfaces receive considerable direct sunlight in the morning and afternoon when the summer sun is low in the sky. Vegetation protecting these surfaces will intercept solar energy that would otherwise overheat the home. In addition, the shade provided by the vegetation will maintain an environment that is several degrees cooler than the temperature in the sunlight.

The recommended way to provide shade is to plant deciduous trees in an arc encompassing the home on the east, southeast, south, southwest and west sides (see Figure 1). When planting shade trees, locate them with an understanding of the mature height of the trees so that they will be properly spaced and provide desired shade. Location of shade trees also depends upon the shape of the tree crown, the position of the sun, the height of the roof or walls, maintaining a desirable view from windows, aesthetic appeal in landscaping a home, and avoiding overhead wires and underground pipes. A tree that is a small twig when planted can grow into a very large tree at maturity and if the mature height and shape is not planned for in advance, the location of the tree may cause problems.

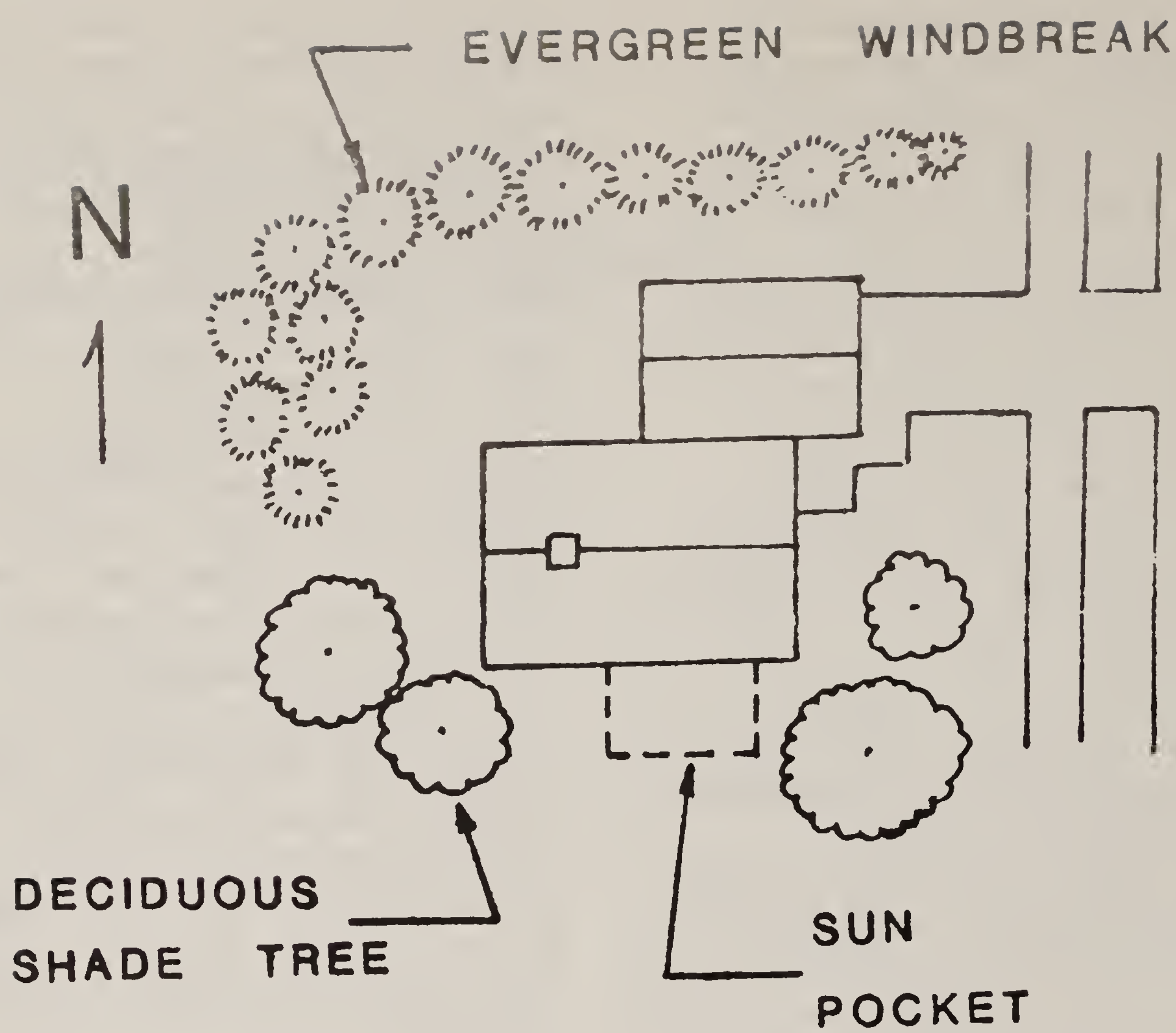


Figure 1. Suggested locations for windbreak, shade trees and sun pocket.

Securing shade for south facing roof surfaces in the summer generally depends on having overhanging tree crowns. Trees which do not overhang the roof will not cast much shade on the roof during midday in summer due to the high position of the sun in the sky. Thus, shade trees should be planted as close to the home as practical. For this location, choose a species that is not susceptible to breakage. Leaves in gutters are an undesirable consequence of large deciduous trees near the home but most people can cope with this nuisance. Prompt removal of diseased or damaged trees or limbs is also necessary to avoid damage to the home from falling debris. Tree planting arrangements which provide shade in summer may be detrimental in the winter if solar heating of the home is interrupted. Leafless deciduous trees in winter may reduce the amount of sunlight reaching the home by more than one-third. However, since the sun in winter is typically less than 45° above the horizon, what shading of the home does occur will be largely by tree trunks. For this reason, only trees necessary for summer shade should be maintained along the southern edge of the home, and the lower trunk should be pruned to allow maximum solar heating of walls and roof in winter (see Figure 2). As few as two or three large deciduous trees with well developed crowns may suffice. If the home has a solar water heating device which needs solar radiation in summer as well as winter, provision should be made that no shade is thrown on the collectors between 9 a.m. and 3 p.m. (standard time) at any time of the year. Thus, leave a gap in the tree canopy to allow

the sun to shine on the collectors during those hours. Since growth of a shade tree is a long term undertaking, fast growing trees can be intermixed among the slower growing more desirable trees to provide a quicker shade. As the slower growing trees begin to mature, the fast growing trees can be removed.

House walls facing either an easterly or westerly direction can be shaded with clumps of vegetation or attached structures. Deciduous or evergreen shrubs or small trees which reach a height great enough to shade the wall may be used. Evergreens may be preferred on the west side to provide both summer shade and winter wind protection for the wall. Vines may be grown directly on masonry walls but should be grown on a trellis if protecting a wooden wall. East or west walls can be provided with immediate shade by constructing a slatted wooden overhead structure attached to the home to provide shade and free circulation of air. Such a structure can be constructed using 1x2 strips of treated pine, redwood or cedar spaced 1 inch apart and attached to the framework. Training vines to grow over the structure will create an arbor (see Figure 3).

Landscaping for Wind Control

The other important climatic element to be controlled by landscaping is the wind. Research conducted on the Great Plains has shown that up to 25% heating energy savings are possible using windbreaks. An evergreen windbreak planting, properly placed, can divert cold winds away from the home. The windbreak should be located upwind from the home in the direction of the prevailing winter wind. In Colorado, this generally means protecting the north and west sides of the home (see Figure 1). The windbreak should be located upwind from the home a distance depending on the tree height. The optimum distance for reducing wind velocity is about one to three times tree height, however reasonable protection is

Figure 2. Effect of deciduous trees in summer and winter.

afforded out to a distance of six times tree height. Windbreaks can cause drifting of snow which can be a nuisance if a driveway is located between the trees and the home. Where possible, the rows of trees should extend fifty feet beyond the ends of the area being protected. However, limited lot size often necessitates reducing both the distance from the home and the length of the windbreak. Design and composition of the windbreak depend upon the space available on the property and upon the species and size of planting stock which can be obtained. Where space is limited, a single row of evergreens is adequate. However, up to five rows consisting of several evergreen species is much more effective. Spacing in one, two and three row windbreaks should be six feet between trees. Plan for the mature shape of the tree when developing a landscaping plan for a windbreak. Most windbreaks can also serve several other purposes: Visual screening can be provided when the trees become five to six feet in height; A well planned and properly maintained windbreak is aesthetically pleasing; Birds and mammals are attracted to trees for protection and food.

Evergreens planted close to the home can further reduce effects of wind. Foundation plantings of spreading evergreens, if allowed to develop into a thick hedge immediately in front of the north and west wall of the house, will provide an additional insulating effect due to the trapped dead airspace created (see Figure 4). If an entry is exposed to wind, an evergreen planting to shelter the entry will be effective.

A windbreak takes time to become established and effective. An immediate step that can be taken to cause relief from the effects of wind is the construction of a fence. A windbreak fence with an open weave pattern (i.e. basket weave) creates a larger protected downwind area than a solid fence. A solid fence provides

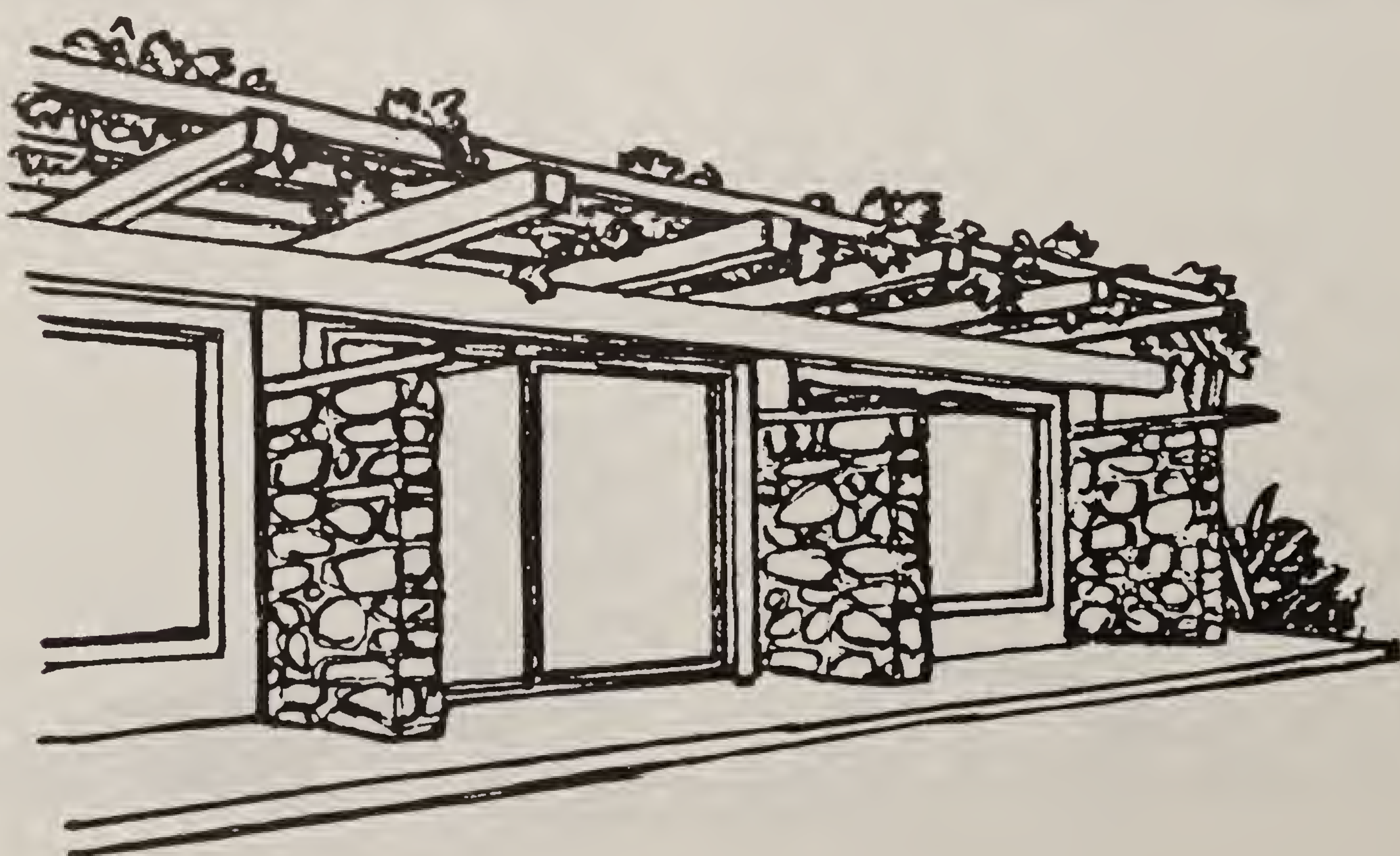


Figure 3. Use of an arbor to reduce solar radiation effects

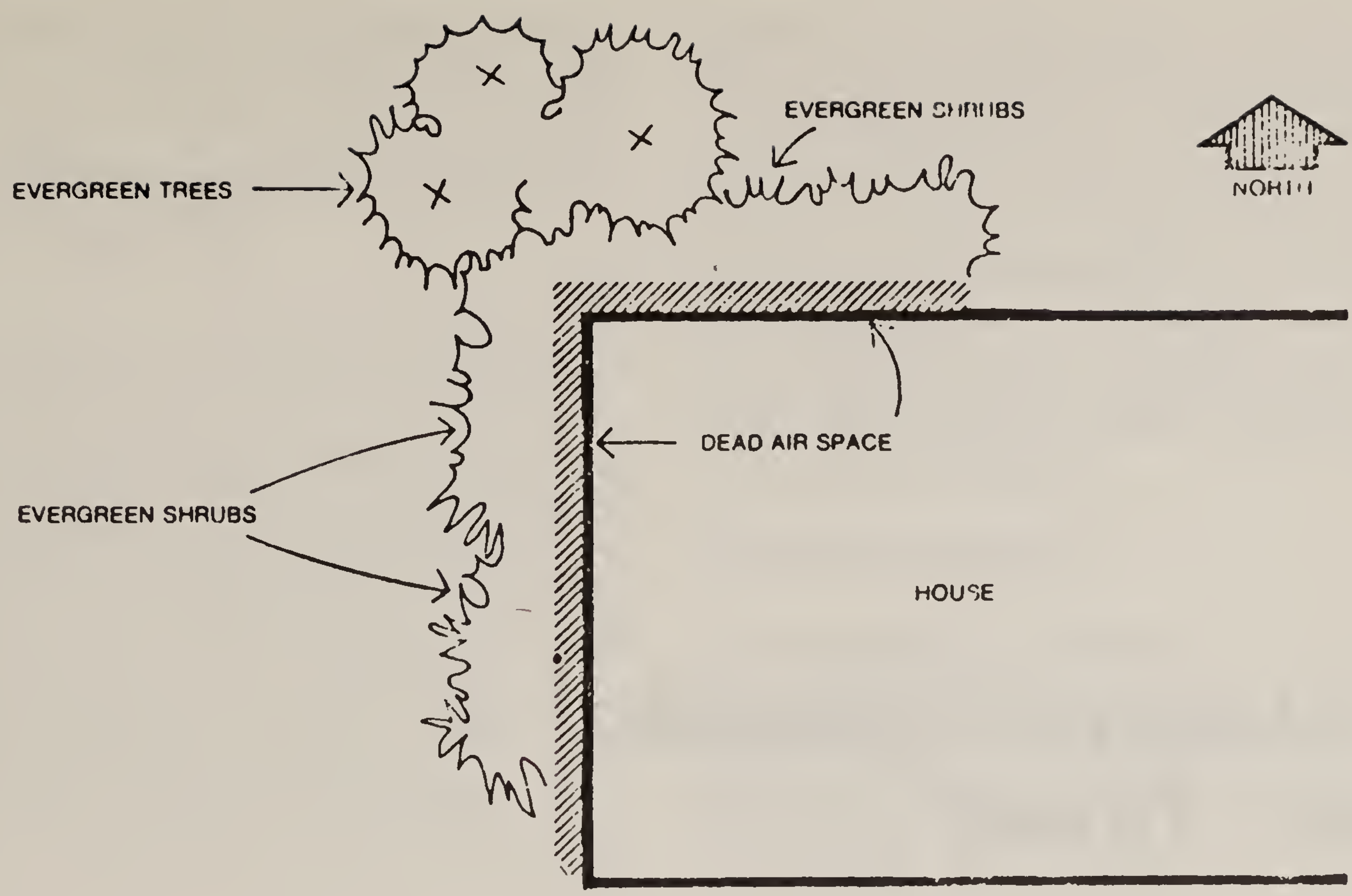


Figure 4. Use of foundation plantings

a greater degree of shelter immediately behind the fence.

How to Plan an Energy Conserving Landscape

Begin by making a sketch of your house and site to scale allowing 1/4 inch for each foot. Identify north, south, east and west. Mark location of doors, windows and other glass areas. Measure the height of the house. Next observe how the sun and wind affect the site. Observe the wind during a winter storm, and note the pattern made by drifting snow as an indicator of the direction of the winter winds. Add windbreaks to your plan to block this wind flow. Observe the sun during different seasons of the year. Notice how the sun strikes the house between 9 a.m. and 3 p.m. in the winter. A south facing solar heating device (including a window) receives the majority of solar radiation between these hours during the winter months. Notice also how the sun strikes the house during the summer months particularly in early morning and late afternoon so that appropriate shading can be provided. At any time during the summer, the sun is not desired and should be blocked (the exception being the use of a solar water heater mentioned earlier). Add shade trees to your plan to maximize summer shading and winter solar heating. Choose specific trees for your plan with an understanding of their mature height so as to determine their proper location for maximum effectiveness. Choose vines and shrubs in a similar fashion. Add manmade structures as appropriate for immediate effectiveness.

Use the elements of fences, windbreak planting and shade trees to provide for creation of a sun pocket on the south side of your home where outside activities can take place during our sunny, cool, but comfortable winter days (see Figure 1). A sun pocket would make an excellent location for a patio or greenhouse addition.

Exotics of Colorado
Yew, *Taxus*

Helen Marsh Zeiner

Many plants are considered, if not impossible, at least difficult to grow in the Denver area. However, if you do a little searching you will find some of these "impossibles" happily established and thriving. An illustration is the yew, *Taxus* sp. In the 1940's, Robert More, an evergreen specialist, said that growing yews in Denver should be attempted only by experts. Although being an expert would surely help, the number of yews to be found in Denver would indicate that if the right conditions are provided, you do not need to be an expert to have a handsome yew.

Evergreen

Yews are evergreen trees and shrubs grown for their attractive foliage and bright fruits. Yews belong to the family *Taxaceae*, the yew family. Most of our common evergreens belong to *Pinaceae*, the pine family. Both *Taxaceae* and *Pinaceae* belong to the great group of plants called gymnosperms, in which the ovules (the structures which become seeds after fertilization) are not enclosed in the ovary but are said to be naked. *Taxaceae* and *Pinaceae* are distinguished by the way in which the ovules are borne. In the pine family the flowers are borne in catkins which become cones with persistent dry and often woody scales or berry-like as in the junipers. The seeds are borne between the scales. In the yew family the flowers are solitary and axillary, and the seed is solitary on a pulpy disk or scale which becomes scarlet-red and forms a fleshy cup-like structure nearly enclosing the seed. This results in bright red "berries" about the size of very large peas.

The needles of yews are dark green above and lighter green beneath. They are two-ranked (in

---

Helen Marsh Zeiner, Ph.D., has been writing the "Exotics of colorado" articles for *The Green Thumb* since April, 1961. Her first article for the magazine appeared in 1950.

two rows along the twig), flat, and have a short, abrupt tip. The dark green makes a nice contrast with the lighter green foliage of other evergreens.

Six species of *Taxus* are distributed throughout the northern hemisphere. They appear to be closely allied and are sometimes considered to be geographical varieties of a single species. The species most often cultivated are *Taxus baccata* L. and *Taxus cuspidata* Sieb. & Zucc., both trees; and *Taxus canadensis* Marsh, a prostrate shrub. In the past *T. cuspidata* and *T. canadensis* were considered varieties of *T. baccata*. From these species many horticultural varieties which are small trees or shrubs have been developed, and it is the horticultural varieties which are usually seen in cultivation, even in climates more suited to yews than Denver.

Yews in Denver

A collection of *Taxus* or yew has been growing for years on the north side of the Museum of Natural History. In the August, 1956 issue of *The Green Thumb,*

Yew, *Taxus*

Robert Woerner, then Director of Denver Botanic Gardens, wrote that several species and varieties of *Taxus* were to be found in the Glenmore Pinetum at the Museum of Natural History. Twenty-five years later, this planting is still to be seen. Mr. Woerner recommended yews for shady areas, and said that some protection from winter sun is essential for their survival.

You will find some yews growing at Denver Botanic Gardens. Several are planted in the herb garden, and some of these have the beautiful red fruits which characterize the genus. Because most yews are dioecious (having unisexual flowers produced on separate plants), not every shrub will produce "berries".

Walking on Denver streets, you may find yews planted as a part of home landscaping. Look for them on the north sides of houses, or where they are otherwise shaded and protected.

Fact and Lore

There are many interesting bits of fact and lore about yews. One interesting fact is that all parts of the plant except the fleshy red pulp of the "berries" are poisonous.

The wood is hard and strong with an attractive reddish color. It is said to be as handsome as mahogany, and is valued for tables and other cabinetmaking From very ancient times the wood of yews was used for bows. *Taxus* is an ancient Latin name, but it may have come originally from a Greek word meaning bow.

Yews for Mourners

Long ago in England, branches of yew were used to decorate a house where a body lay awaiting burial. Mourners wore yew around their heads. Yews were often planted in church yards because they were a symbol of immortality. A yew tree drooping over a grave was often embroidered on samplers, so popular a century or so ago. Yews are long-lived, and the name yew may have come from the same root as a German word for everlasting.

In nature, yews grow in more humid climates than ours with less intense sun, and prefer moderately moist sandy loam. If you want to try a yew, plant on the north, keep moist, provide some winter protection, and hope for the best!

References

Bailey, L. H. 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

Rogers, Julia E. 1905. *The Tree Book.* New York: Doubleday, Page & Company.

Woerner, Robert L. "Conifers at the Botanical Garden." *The Green Thumb* (August, 1956), p. 31.

When is a Leaf not a Leaf—

Plant Modifications That Can Be Seen In Boettcher Memorial Conservatory

Vickey Trammell

The typical flowering plant has three vegetative organs: roots, stems and leaves. These organs are familiar and their functions well known. However, in certain cases they have become modified, taking on different functions and often different shapes.

The Boettcher Memorial Conservatory at Denver Botanic Gardens is an excellent place to observe various modified plant parts. The examples given are found in the Conservatory and are named and numbered so interested visitors can see them.

Modified Leaves

The leaf is the main photosynthetic organ of the plant and is highly specialized for that function. The STAGHORN FERN (*Platycerium bifurcatum* (Cav.) Chr. — 20L) has typical photosynthetic leaves that are branched to resemble "stag's horns." This fern also has **clasping** or **shield leaves** that hold the fern onto the tree trunk.

Vickey Trammell, a graduate of Baldwin-Wallace College, Berea, Ohio, and a former student of Dr. Wm. Gambill at Ohio University, is a biology instructor at Arapahoe Community College, Littleton, Colorado.

They are thick and rather scalloped on top. They do contain chlorophyll but photosynthesis is not their only function.

What appear to be colorful "petals" on certain flowers are not petals at all but are **bracts,** a type of modified leaf. The red, leaf-like structures on the Poinsettia are bracts. In the Conservatory bracts can be seen on the MAUNA LOA (*Spathiphyllum* Schott cv. — near 27R). This white bract subtends a prominent spike-like structure, the spadix, on which are crowded numerous tiny flowers.

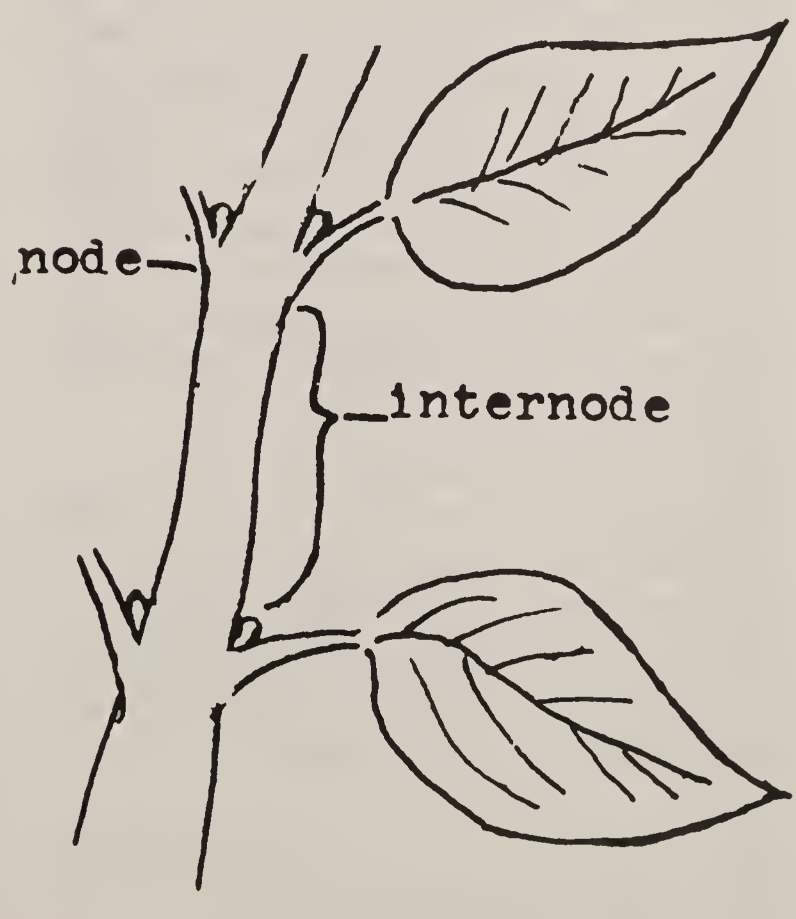


Fig. 1. Nodes and internodes

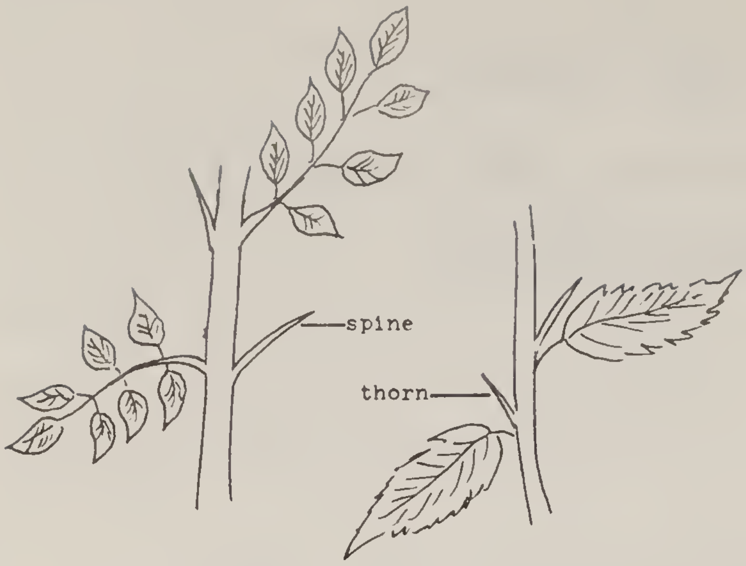


Fig. 2. Spines and thorns

Leaves arise from stems at nodes (Fig. 1). This is important to remember when trying to tell a spine from a thorn. **Spines** are modified leaves; they develop on the stem at nodes just as true leaves would. **Thorns,** on the other hand, are modified stems. They arise in the leaf axils as do the buds of next year's stems (Fig. 2).

In their adaptation to dry conditions cacti have developed much reduced leaves, the so-called "scale leaves" which are dropped after a very short time. Dropping of these leaves conserves moisture which would be lost from the plant by transpiration. More visible are the ever-present, sharply pointed **spines** of the GOLDEN BALL CACTUS (*Echinocactus grusonii* Hild. — 62L) which effectively protect the cactus from being eaten by grazing animals. These spines may be considered as structural equivalents of leaves but do not completely replace leaves.

The "thorns" on the CROWN-OF-THORNS (*Euphorbia milii* Desmoul. — under 53R) are actually modified stipules which are paired structures occurring at the bases of leaves. Since stipules are part of the leaf, these should be called **spines.** They are located on either side of the leaf stalk if the plant is in leaf, otherwise on either side of the leaf scar (Fig. 3).

Fig. 3. Modified stipules on Crown-of-thorns

Leaves can be used as storage organs. This is especially true of **bulbs** which are vegetative reproductive plant forms and consist mainly of modified storage leaves. Bulbs are usually underground structures, but the bulbs of the CLIMBING ONION (*Bowiea volubilis* Harv. — 55R) are above ground.

When bulbs are underground they do not develop chlorophyll and do not carry on photosynthesis. Some leaves have retained their chlorophyll but are also modified for storage. This is true of any plant with succulent leaves. Water is stored in the leaves, another adaptation to dry conditions. You can see succulent leaves on the SILVER DOLLAR (*Crassula arborescens* (Mill.) Willd. — under 53R).

Leaf shape may show modifications in adapting to harsh environmental conditions. Plants of dry climates usually have relatively small leaves. This results in reducing transpiration and

conserves water. The needle-shaped leaves of NORFOLK ISLAND PINE (*Araucaria heterophylla* (Salisb.) Fr. — 97R) and the scale leaves found on all junipers are examples.

Many climbing plants put out **tendrils.** However there can be leaf tendrils or stem tendrils depending on the derivation of the structure. GRAPE IVY (*Cissus rhombifolia* Vahl. — down the hill from 45R) has leaf tendrils. They emerge at the nodes and so, according to our definition, are modified leaves (Fig. 4).

Fig. 4. Leaf tendril

Modified Stems

Stems contain vascular tissue that transports water and dissolved substances from the roots to the aerial portions of the plant. In herbaceous plants and young woody plants the stems can contain chlorophyll and thus carry on photosynthesis. The photosynthesizing stem is very highly developed in the cacti and other desert species that have much reduced leaves or no leaves at all. Revisit the GOLDEN BALL CACTUS and notice the photosynthetic stem. The stem also serves as a water storage area for the cactus.

Fig. 5 Thorn on *Bougainvillia*

Thorns are modified stems because they are found in the axil of the leaf (Fig. 5). You can see thorns on the older twigs of 'Panama Pink' (*Bougainvillia spectabilis* Willd. —100R on balcony). **Stem tendrils** also arise in the leaf axils (Fig. 6). These modified stems can be seen on the PASSION FLOWER (*Passiflora caerulea* L. — 73R).

Stems also function in vegetative reproduction. A **stolon** or **runner** is a horizontal, above-ground stem from which small plants arise at nodes. The classic example of a stolon is the runner on a strawberry plant. The familiar SPIDER PLANT (*Chlorophytum capense* (L.) Voss 'Variegatum') exhibits stolons. In the Conservatory spider plants can be seen as ground cover between 77R and 74R.

Fig. 6. Stem tendril

120

Fig. 7. Cladophyll of *Ruscus hypoglossum*

Rhizomes are enlarged underground structures classed as stems because they have nodes and internodes. Rhizomes are not easily seen in the Conservatory because they are generally underground. The best visible example is the CLIMBING FERN (*Stenochlaena palustris* (Burm. f.) Beddome — uphill from 17L) on a tree stump. In ferns the fronds (leaves) always grow out of rhizomes, which are usually underground. This fern has rhizomes modified for climbing.

The strangest example of a modified stem is the **cladophyll,** a leaf-like stem. These can be seen on *Ruscus hypoglossom* L. (across the path from 73R). The small flower seems to be growing directly out of a leaf (Fig. 7). In this plant what appear to be leaves are, in reality, flattened green stem segments.

Modified Roots

Roots anchor the plant and absorb water and minerals from the soil. They do not have nodes and are usually underground.

Any root that arises in an unusual place on a plant is called an **adventitious root. Prop roots,** a kind of adventitious root, do exactly what the name implies. They prop up or provide support for the plant. The SCREW PINE (*Pandanus utilis* Bory — 24R) exhibits prop roots that anchor it in the wet soil in which it grows. Other types of adventitious roots enable plants to climb or cling to trees or other structures. The MEXICAN BREADFRUIT (*Monstera deliciosa* Liebm. — 83R), native to the jungle, has **aerial roots** that help the plant climb trees in order to obtain more light. Aerial roots, that are only tiny rootlets, can be seen on the climbing stems of ENGLISH IVY (*Hedera helix* L. — growing up and around the flame tree to the right at the entrance of the Conservatory). These aerial roots enable the ivy to cling to structures, including buildings, upon which they grow.

These are just a few of many examples of modified plant parts that can be found in the Conservatory. How many can you find on your own?

Insects and Plants — Some Interrelationships

Url Lanham

Of the million or more species of insects that exist, about half feed on plants. Taken together insects feed on all parts of the plant, but usually each kind is more or less of a specialist. Some graze on leaves or bore through wood with toothed mandibles that nip and grind. Others have the mouth fashioned into a slender hollow needle that penetrates the plant tissue, then draws out the plant juices, or floods more solid tissues with digestive enzymes and drinks the liquified product. Many are so small as to tunnel between the upper and lower surface of a single leaf; others may grow to full size inside a small seed.

Diet Preferences

Some insects eat many kinds of plants. The gypsy moth caterpillar, for example, feeds on more than four hundred species. But usually most will starve rather than eat any but one or a few kinds of plants, as the person who tries to rear a captive caterpillar often discovers. Even with a catholic diet, there are preferences for one kind of plant over another, and for good reason. Caterpillars of the European nun moth have a 98% survival rate on leaves of such varied plants as apple, spruce, or some species of oaks. But on other plants, which they will eat if there is nothing better, the death rate is about 60% (pine) or 90% (alder).

Defenses

Plants are not passive victims of insects or any other animal, seen in the perspective of evolutionary history. Plants continually evolve new means of defense, insects new methods of attack. Plants have external defenses such as spines or thickened leaf armor and internal biochemical machinery which produces repellents and poisons. Insects respond with improved methods of biting and chewing and internally with enzymes able to take apart the plant toxins.

It is plant poisons, which defend against both insect and vertebrate herbivores, that have most interested people. The most important class of plant toxins is the alkaloids, bitter tasting substances that warn potential consumers. Caffeine is a familiar alkaloid, its taste masked by the aroma of roasted coffee beans. Theine of tea and theobromine of chocolate are similar alkaloids. Morphine and codeine are alkaloids produced by the opium poppy and several other species in entirely different groups of plants. The United States Department of Agriculture some twenty

---

Url Lanham, Ph.D., is Curator of Entomology at the University of Colorado Museum, as well as Professor of Natural History at the University. He has prepared the brochure which accompanies the Insect Portraits by SuZan Noguchi Swain displayed during January, 1982, at Denver Botanic Gardens.

years ago published a list of 3,500 species of plants containing about 2,000 kinds of alkaloids. Most or all of these substances are lethal to man in rather small amounts — about 2.5 grams of caffeine, for example, and much less for some others. There are also other classes of plant substances toxic to both insects and vertebrates.

Such plants as tomatoes and tobacco are heavily defended by alkaloids in their leaves, and have relatively few kinds of insect enemies. Yet some are specialists on these plants. Every gardener is familiar with the incredible consumption of tomato leaves by the huge tomato hornworm. Such specialists escape competition from the more generalized insect feeders, but must develop physiological methods for sequestering or disassembling the toxic alkaloids.

New Tastes

In nature populations of insects show the genetic flexibilities needed to change from one food plant to another. In the Frazer River area of the Pacific Northwest an imported tree, the Lombardy poplar, flourished until the satin moth was introduced, which almost exterminated it. The moth then began to feed on the botanically related cottonwood. It was known that the poplar-reared caterpillars suffered heavy mortality when fed cottonwood leaves. The theory is that enough survived to found a genetically new race of the moth that now thrives on cottonwood.

Probably the same kinds of genetic variation that enable insects in the wild to adjust to new plant hosts are used to develop resistance to agricultural insecticides. While it is true that many of the artificial poisons have never before been encountered by insects, there are certain atomic configurations and bonds within the insecticides that are the same as those in compounds long known to the insects in nature, compounds which are regularly metabolized by the insect. Genetically based variants of the enzymes that do this are able to handle the new insecticide molecules, at first only inefficiently. In a matter of years selection perfects the enzyme system to the point where the insect is immune to the insecticide.

A Home for the Newborn

Most species of insect have complete metamorphosis, with a more or less immobile larva adapted for feeding and the highly mobile adult responsible for putting the egg where the newborn larva finds itself surrounded by food. For the plant-eating insects, this means that the adult must have the built-in behavior to find the right spot in the checkerboard diversity of a largely hostile plant world. Visual clue, odor, feel and taste are among the stimuli that are used to trigger egg-laying behavior. A species of fly whose larva devours seeds of a cocklebur (*Xanthium* L.) will not lay its eggs on a burr whose hooked spines have been clipped off, but will lay them on a cork bristling with hooked pins.

Biological Control

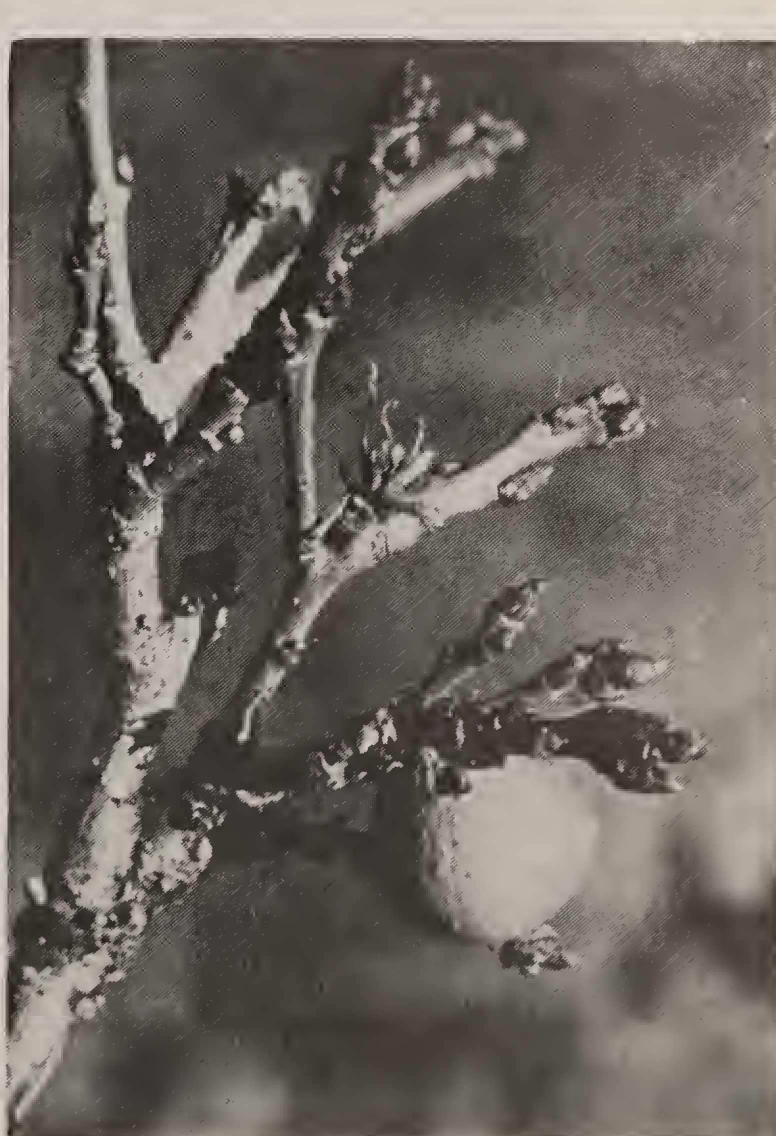
Insects that are genetically programmed to eat a particular kind of weed are good candidates for biological control. An especially pernicious weed, the Klamath

weed (*Hypericum perforatum* L.) poisonous to livestock and competing well with other plants, reached the United States from Europe as early as 1900. This plant of the St. Johnswort family is found on hundreds of thousands of acres in the American northwest, Australia and New Zealand. A heavy stand grows in Colorado west of Rocky Flats, near Boulder. It has been cut down to the status of a nuisance rather than a devastator by importing a pea-sized, bright metallic beetle (*Chrysolina*) from Europe. After a few decades of experimenting here and in Australia, which confirmed that it would not eat any of the important economic plants, it was turned loose on the weed. Also, strains that were adapted to local climates were developed. This beetle was purposely introduced into the Rocky Flats stand. This beetle is now abundant there, and also has found its way to scattered plants that have strayed to the mesas west of Boulder. The introduction of this beetle at Rocky Flats probably should be credited for preventing a serious infestation of this part of the State by the Klamath weed.

A large percentage by weight of the standing crop of organic substance on the earth is wood. Wood is nearly 50% cellulose. The energy-rich cellulose can be digested by many of the wood eating insects. Termites, which sooner or later chew up most of the wood produced in the tropics, cannot themselves digest it, but have the gut crammed with microorganisms that can do so. Lignin, which makes up 20-40% of the wood, cannot be used by insects, so far as known.

The Gall-makers

Some thousands of species of insects, mostly belonging to the families *Cecidomyidae* (gall midges) and *Cynipidae* (gall wasps) have taken advantage of plants in a remarkably devious way. Larvae of these insects, hatching from eggs laid inside the plant tissue, secrete substances which redirect the growth of the plant which is of use, not to the plant, but to the insect. The abnormal structure is, of course, the gall. The gall gives the larva a physical shelter, protecting it from weather and some of its biotic enemies, and, as well, producing a specialized nutrient layer eaten by the larva. It seems especially remarkable that a group of related gall makers will produce galls of similar structure on quite unrelated plants. The converse also is true: different



Oak-apple Gall — Home for the Larva of a Cynipid Wasp

Stem Gall of Desert Trumpet

kinds of gall wasps infesting a single oak leaf will produce several different kinds of galls, each characteristic of the species of wasp.

Mutual Benefits

The relationships between plants and insects already mentioned are antagonistic. There are, in contrast, many which are mutually beneficial or symbiotic. The most widely studied of these, the subject of countless books and technical papers, is that in which insects make possible sexual reproduction in plants by transferring pollen from one plant to another. Pollen grains are diminutive male plants that sprout when placed on the stigma of the flower. A tube which grows down to the base of the stigma carries the male gamete (equivalent to the sperm cell) which fuses with the egg cell. Some plants set seed without cross pollenization, either using their own pollen, or the egg develops without being fertilized. However, in the long run nearly all of the flowering plants at least occasionally reproduce sexually, thus enriching the genetic mix handed on to the offspring.

The main inducements offered by plants to insects are nectar and pollen, advertised by perfumes and attractive shapes and colors. A minority of plants are pollinated by such winged animals as bats and hummingbirds. Among those pollinated by insects, most use bees. The bees themselves use large quantities of pollen to feed their young, which are reared almost exclusively on a diet of pollen and nectar. In the process of gathering pollen loads for their own use, the bees transfer the few grains needed for fertilization to the stigmas of other flowers visited during their hunt for pollen. Fortunately for us, bees find the same kinds of flower odors attractive that we do, so help to make the world a pleasant abode. Also, the geometric, symmetrical patterns which most effectively stimulate the compound eye of the bee give us visual pleasure. Some fly-pollinated plants have unpleasant odors like those of decay.

The domestic honeybee is only one of the some 20,000 species of bee that exist throughout the world. Most of these are not social, in the manner of the honeybee, and differ much in structure and color from the honeybee. The female of the solitary bee fashions a simple nest, usually dug in the ground with 10-30 brood cells. Each cell

is filled with a ball of pollen and nectar, an egg is laid on it, and the cell is sealed by the mother, who soon dies, never seeing her offspring. After hatching, the larva devours the pollen mass, transforms into the adult, usually during the same summer, then sleeps underground through the winter, to emerge the following season at the right time to hunt pollen and nectar on its favorite flower.

Nectar of flowers, a watery solution of sucrose (ordinary table sugar) and its constiuent sugars, glucose and fructose, is the fuel used for flight by a host of insects other than bees. Wasps, butterflies, moths, and thousands of species of the true flies (the two-winged Diptera) put in many tens of thousands of miles of flight pursuing their varied pleasures and tasks "burning" nectar gathered from a few acres of flowery meadow.

A Relationship Beneficial to Both Plant and Insect

INDICES

ANNUAL REPORT 1980

SUBJECT INDEX 1981

(Spring pp. 1-32, Summer pp. 33-64, Autumn pp. 65-96, Winter pp. 97-128)

AUTHOR INDEX 1981

ARTIST INDEX 1981

Photo Credits

Denver Botanic Gardens, Inc.
A Non-Profit Organization

Officers

Richard A. Kirk	President
Edward P. Connors	Vice President
Newell Grant	Vice President
Moras L. Shubert, Ph.D.	Secretary
William J. Lunsford	Treasurer

Staff

Merle M. Moore	Director
Andrew Pierce	Assistant Director
Gloria Falkenberg	Director of Development
William G. Gambill, Jr., Ph.D.	Director Emeritus
D. H. Mitchel, M.D.	Honorary Curator of Mycology
Bernice Petersen	Honorary Editor of *The Green Thumb*
Helen Marsh Zeiner, Ph.D.	Honorary Curator of the Kathryn Kalmbach Herbarium

Illustration Sources

Front cover: Drawing by Frances Frakes Hansen
Page 99: Drawing by Kathleen Hoeft
Pages 101, 123: Photographs by Albert E. Daraghy
Page 103: Drawing by Janet Wingate
Pages 110, 111, 112, 113: Drawings by Lloyd Walker
Page 115: Drawing by Doris Peacock
Pages 117, 118, 119, 120: Drawings by Vickey Trammell
Pages 124, 125: Photographs by Loraine Yeatts

The Green Thumb

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

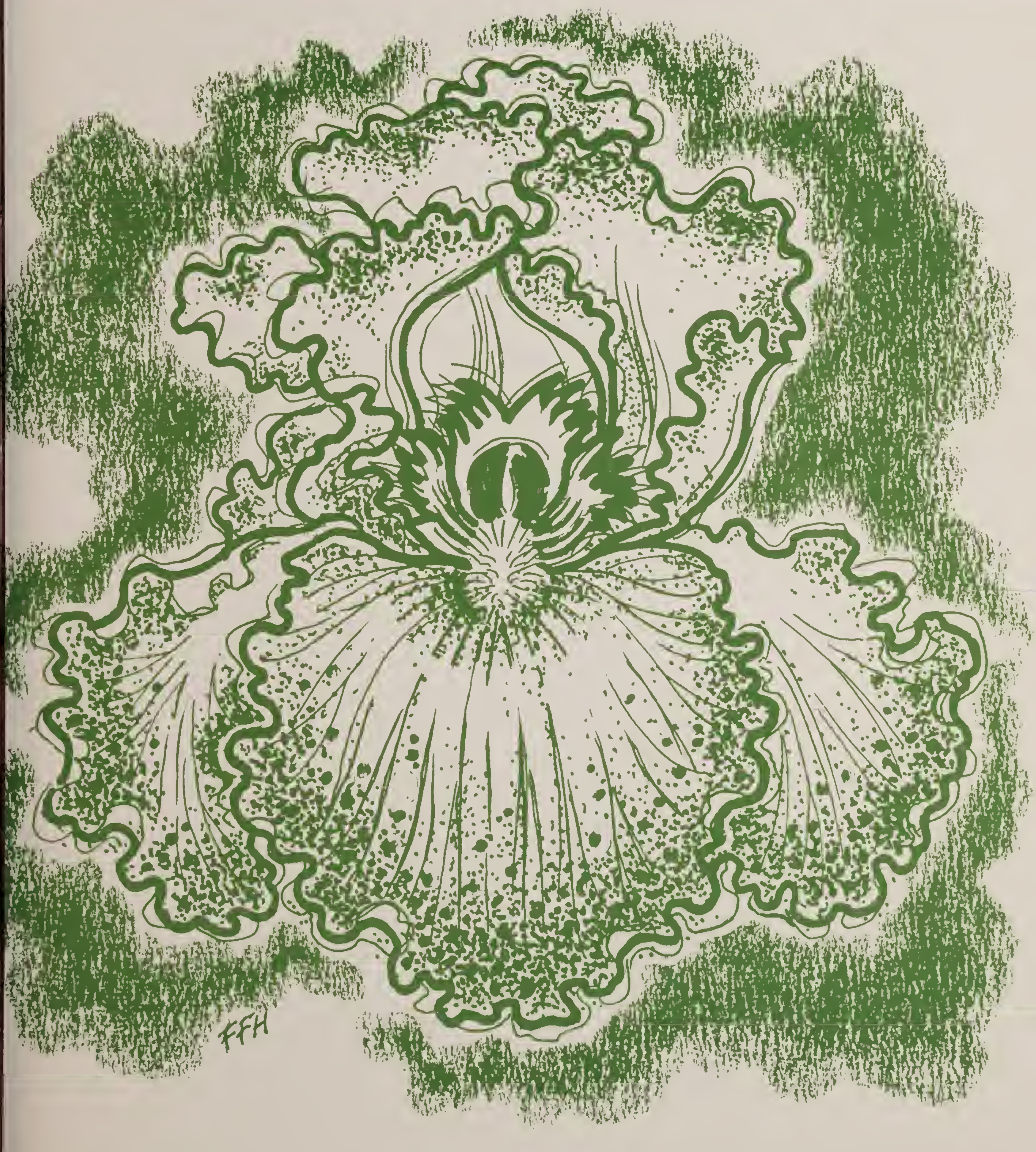
NON-PROFIT ORG.
U. S. POSTAGE
PAID
Permit No. 205
Denver, Colorado

Do Not Fold

The Green Thumb

Spring 1982

Vol. Thirty-nine
Number One



The Cover
Tall Bearded Iris
Frances Frakes Hansen

The Green Thumb
Spring 1982
Vol. Thirty-nine, Number One

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2548.

The Green Thumb

Spring 1982

Velma A. Richards
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Growing Japanese Irises In Colorado

Harlan Clark

The first time I visited the Japanese iris gardens at Meiji Shrine in Tokyo, they were in full bloom and I immediately resolved to raise some of these beautiful flowers in my own garden when I retired. That was in 1957 and the many years and travels that intervened before my coming to Colorado in 1970 to retire—at last—did not change my mind in that respect. Something else did for a while, and that was the discovery that here in the southwestern outskirts of Denver, as in most other parts of Colorado, we have a highly alkaline clay soil wholly unsuited to growing acid-loving *Iris enasata* Thunb. (*I. kaempferi* Sieb.)—quite apart from the relative scarcity of water so dear to the Kaempferi palate.*

Then through my membership in the Species Iris Society, I was led to hope that a micro-habitat suitable to the growth of Japanese irises and other acid-soil plants could be created in one's garden and that water requirements should be no more than for the rest of the garden. The trick lay in creating the so-called acid bed. Through this hint from an article in *Signa,* the Species Iris group's publication, I was led to both the Japanese Iris Society and to a Melrose Gardens catalogue containing instructions for constructing such an acid bed. Additional helpful hints came from a Round Robin letter of Japanese Iris Society members.

By this time I was busy building my own rather small acid bed and reading everything I could find locally about Japanese iris culture. An article in *Signa* indicated that Kaempferi seems to tolerate sodium salts but not calcium salts, which suggests that Japanese irises had their origin near the salty marshes by the sea.

While it is easy to purchase locally or scrounge materials for an acid bed, my preparations were facilitated by the presence on our mountain land of black soil lying in old pond beds, rich in humus and decomposed granite, with a pH of 6.2. There were also great quantities of lichen-covered rocks, which I used to construct the raised beds in which I plant all my shrubs and flowers. I adjust the pH to plant needs by adding such things

---

Harlan Clark retired in 1970 after serving 33 years in the U.S. Foreign Service. Most of his assignments were at overseas posts. At the time he became interested in Japanese iris, he was at the U.S. Embassy in Tokyo as Chief of the Political Division.

*The cultivated Japanese irises are all derived from one species, *Iris ensata* Thunb., but are commonly called Kaempferi irises because they have been thought to be cultivars of the species *I kuempferi.* Sieb., now listed a synomym for *I. ensata* Thunb. Ref: Warburton, B. and M. Hamblen, Eds. 1978. *The World of Irises. p. p. 30-31.* Wichita, Kansas: The American Iris Society. Ed.

as old sawdust to produce further acidity, or ground limestone for alkaline lovers like clematis and bearded irises. The mountain soil to which I refer seemed to be just right for Siberian irises but it needed to be even more acidic for Kaempferi. That was easy to arrange through the addition of flake sulfur, sphagnum moss and other acidifiers. I never use aluminum sulfate for this purpose, however, because of toxic side effects that have been observed.

It is equally as important to maintain the acidity level in the acid bed once the Japanese irises have been planted. That would be difficult enough if one had only to contend with the flow of alkaline salts into the bed every time it is irrigated with local city water. The main threat, however, seems to be the rise of alkaline salts by diffusion from the clay underlying the acid bed. It is simple enough to deal with the latter problem by laying a sheet of plastic over the clay before filling the bed with the specially mixed soil. After digging all the clay out of the bed to a depth of 18-20 inches I used heavy plastic sheeting to line the hole, so it looked something like an empty lily pool. The bed was located on a slightly sloping piece of ground. To provide necessary drainage I cut a small hole in the plastic at the lower end of the cavity and ran one-inch black hose

Japanese Iris in Harlan Clark's Garden

pipe from the upper end of the bed through the hole and along a ditch (later covered) to a point about 20 feet beyond the bed where I could install a threaded fitting and screw cap to permit periodic draining of any water in the bed (once a month or so). I drilled a line of holes in the 12-foot portion of pipe lying on the bottom of the bed itself to facilitate even drainage along the entire slope of the bed. Having sealed the pipe to the plastic with silicone glue at the point where I had cut the hole, I filled the bed with the acid mixture.

It is worth noting that Japanese irises do not tolerate being immersed in water during periods of dormancy and really seem to prefer nestling at or slightly above the edge of boggy pools, though they will grow happily immersed in water during the spring and summer months. I never keep my acid bed flooded for long and doubt that it has much more moisture in the soil during the summer months than any other well-constructed flower bed. In the late fall I remove the drainage plug entirely counting on the rain and melting snows to leach accumulated salts from the bed. When the iris shoots begin to sprout in the spring plenty of water is needed. If the rains falling then are heavy there is more promise of heavy bloom come mid-summer

The irises sent up spikes the first year after they were planted and have bloomed profusely almost every year since 1973. I say almost every year because there have been some lean ones. I had been warned to replant Japanese irises every three or four years; since, for apparently obscure reasons, they seem to gradually diminish in vigor and die thereafter.

There were also the learning pains of what animal and fungus pests to cope with. Cut worms will climb high on the bloom stalks to sever one's best new spikes; slugs will feed on the leaves; and in some years grasshoppers can be a menace. Other peculiar things happen that suggest unseen borers are at work below and diseases resembling crown rot are attacking some plants. I never lost a clump once established, and I have avoided overkill in the treatments used. Perhaps diazinon granules on the bed and Orthene sprayed once or twice a growing season have been the most effective insecticides used. Terrachlor has helped against disease, and I have also sparingly used fungicides like Benlate and Funginex.

A few years ago I decided to dig up the whole bed except the rock garden and replace the ruptured plastic sheeting. Except for that necessity, to keep out the roots of nearby cottonwoods, I feel sure the bed would have received only little upgrading during replanting. Again this year every clump but one looks great; and if the hailstorms will cavort elsewhere and the locusts do not descend, I shall have something special to celebrate on the Fourth of July — Japenese iris blooms as big around as a small dinner plate and much, much more beautiful.

References

Melrose Gardens Catalogue, 309 Best Rd. South, Stockton, CA 95205

Signa, publication of the Species Iris Study Group of the American Iris Society. Davidson, B.L. ed. 1972-

Iris At Colorado State University

Carl J.C. Jorgensen

When asked to write an article about iris at C.S.U., it seemed only natural to narrate in a chronological way the events that have transpired here at Fort Collins and the personal experiences that are so vivid after so many years.

In 1950, three years after arrival in Colorado, the writer requested the Horticulture Department to purchase 25 Dykes Medal irises, among them such standouts as 'Ola Kala,' 'The Red Douglas,' 'Wabash' and 'Blue Rhythm'. These were planted on campus and used by our students to practice propagation by division and also hybridizing since the large flower parts made iris an ideal study plant. Subsequent pod production led to the planting of the seed. However, few seedlings resulted. Study of the literature indicated that low germination was to be expected. In fact, studies done elsewhere indicated that seed dormancy could delay germination up to 15 years. This made serious studies on population ratios and segregation in tetraploid iris very frustrating and was a serious retardant to scientific iris breeding. For several years it was to remain of academic interest only for us.

During the '50's, the number of named varieties grown at C.S.U. increased to over 100.

Germination Research

In 1963, Denver was the site of the national iris convention, and although this writer had been a member of the American Iris Society, he did not become involved until attending that event. The new varieties and colors so impressed him that with department funds and gifts of iris from Denver Botanic Gardens and interested breeders, 200 new varieties were planted at C.S.U. in an area along University Avenue in the heart of the campus. These bloomed every year at graduation time. Also in 1963, a decision was made to research, if possible, germination problems with tall bearded iris. A monograph by L.F. Randolph and Leland Cox of Cornell University provided a good starting point. From 12,000 seeds, average germination was 35%. Varying treatments included high and low temperature storage of moist and dry seed, alternating temperatures, varying pH and light, increased oxygen as well as embryo culture. Chipping of the seed, with and without increased oxygen, plus leaching in water resulted in significantly higher germination. Failure to obtain good germination by these treatments suggested that the inhibiting substances were highly stable compounds, relatively

---

Carl J.C. Jorgensen, Ph.D., is Emertius Professor of Horticulture at Colorado State University in Fort Collins, Director of the Trial Gardens there, and a contributor to *The World of Irises* published by the American Iris Society.


Dr. Jorgensen with '82 Guest Irises

insoluble in water and not readily diffusable from the region around the embryo. Research in 1962 and 1963 by Dr. James Ells of C.S.U. on the chemical treatment of crop seed to hasten germination showed promise.

The writer submitted a research proposal to the C.S.U. research committee. This was approved and a substantial grant provided. The goal was to increase germination percentage and reduce delayed emergence of iris seedlings. A reasonable goal, we thought, might be 80% germination. We would concentrate on treatments and methods to reach that goal. The 1963-64 experiments involved chemical and leaching treatments of varying time durations. Three thousand seeds of tall bearded iris were involved. (Several well known iris breeders had generously provided us with 5000 seeds of known crosses.) C.S.U. provided greenhouse and laboratory space and college students did some of the laboratory work, seedling counts and transplanting. Although many of the treatments increased germination, they were as a whole disappointing. A report was presented to the 1964 national convention of results of these treatments. Along with chemical and leaching treatments, embryo culture was tried. While removal of embryos was fairly simple, it did not, because of special equipment and technique needed, lend itself to practice by the average breeder. Growth on the nutrient agar was slow and a 50% mortality occurred in transplanting the seedlings. Meanwhile those seedlings from natural germination far outdistanced the cultured embryos in size and vigor. Obviously other avenues of research had to be found.

Germination Inhibitors

On to research in 1964. In addition to variations of treatments used in 1963, another phase of research was initiated. What were these inhibitory substances in the seed coat and embryo that Randolph and Cox had found and could they be isolated? Seed samples were ground up and separated into water soluble and ether soluble fractions. Using crop seed having high germination, the inhibitory effects were determined by measuring reduced percentage of germination as well as reduced shoot and radicle length. Analysis by paper chromatography indicated the presence of phenolic substances in the iris extracts. These are probably responsible for inhibition of germination. One treatment that dramatically improved germination of iris seed consisted of presoaking seeds in water for 14 to 21 days and removal of the outer seed coat to expose the micropyle. By means of a binocular microscope and under aseptic conditions, the cap of endosperm tissue covering the radicle of the embryo was removed. Such seeds,

when placed between layers of sphagnum moss under greenhouse conditions, germinated promptly up to 90% and produced normal seedlings. Still it was not practical for the average iris hybridizer.

1965 proved an eventful year. The C.S.U. Trial Garden became an official Region 20 test garden. Area hybridizers could send promising seedlings. Test garden irises are identified only by code number. This insures unbiased evaluation by judges. C.S.U. was also designated one of the sites for the 1967 convention and 200 guest irises were planted in summer of 1965 in anticipation of the 1967 national convention. The Trial Garden was moved to the East Bay Farm location that year. The writer presented a paper that June to the national convention on inhibitors in iris seed. This subsequently appeared in the A.I.S. Bulletin (Jorgensen, 1965). Research continued into 1966 with funds provided by Region 20 and the American Iris Society. A second research paper on germination of specific crosses appeared in the A.I.S. Bulletin (Jorgensen, 1966).

Over 300 conventioneers made the trek to the campus in June 1967 to see the 200-plus guest irises sent to C.S.U. for that convention. A hiatus in iris work occurred between 1967 and 1970, since the writer was on a government assignment to Colombia, South America. The Trial Garden suffered as a result; but with the financial help of Region 20 and the Elmohr Iris Society, it was rejuvenated in 1970 and many new varieties planted. Students again began using iris for plant propagation and hybridizing studies. The move to our present location on the Bay Farm was accomplished in 1971.

A term as Regional Vice President gave the writer an opportunity to review some possible avenues of practical iris research. Weed control, control of botrytis, and germination experiments were undertaken. Emerging in the mid '70's were the results of the use of Dacthal and Treflan as excellent pre-emergence herbicides. These, incorporated into the soil around established iris plants, or into the area to be used for transplanting seedlings, prevented weed seed germination for up to three months. Also effective but more dangerous and requiring special care in application were 2, 4-D and the new Roundup—the latter specifically for general weed control rather than application around the iris plants. In 1972-73, a study in cooperation with Schreiner's, commercial iris growers, proved the effectiveness of Benlate in botrytis control and reduction of transplant losses on newly established iris rhizomes.

Germination Breakthrough

A real breakthrough in improved bearded iris seed germination occurred in 1975-76. It had practical implications since now the average irisarian could increase germination without resorting to embryo culture or other difficult treatments. Breakdown of iris inhibitors occurs naturally, especially if the ripe seed is subjected to warm moist conditions for a month prior to moist stratification at near freezing temperatures for 110-120 days. This method was described in detail in the A.I.S. Bulletin (Jorgensen, 1979). The procedure is currently being used by many hybridizers. Stored seed can be manipulated on a time schedule to fit subsequent germination in a greenhouse or germination out of doors.

We now come to the present. The C.S.U. Trial Garden is designated as one of the official sites for the 1982 Colorado convention. Some 600 named varieties and seedlings were planted in 1980 as guests from hybridizers throughout the United States. These will be seen by conventioneers on June 4, 1982, when American Iris Society members come to the C.S.U. campus. In addition older varieties will be on display as will many first year and selected seedlings by Colorado hybridizers.

Rendezvous '82 - We're waiting for you!

References:

Jorgensen, Carl J.C. 1965. Inhibitory Effects of Iris Seed Extracts on Germination, *Bulletin A.I.S.* 279: 27-31.

________________1966. Germination of Two Specific Iris Crosses. *Bulletin A.I.S.* 183:60-67.

________________1979. Some Thoughts on Breeding Tall Bearded Iris. *Bulletin A.I.S.* 234: 41-44.

Randolph, L.F. and Leland Cox. 1943. *Factors Influencing the Germination of Iris Seed and the Relation of Inhibitory Substances to Embryo Dormancy.* New York: Cornell University.

Iris tectorum, A Crested Iris

The World of Wild Irises

Panayoti Peter Callas

A gardener who knows only tall bearded irises might be compared to a person on a diet who samples only a single course at a lavish banquet. The smorgasbord of iris species is vast and varied. Some three hundred species occur throughout the northern hemisphere, from icy tundra to parched deserts. In a garden, one or another sort of wild iris could be found to grow in almost any microclimate one can contrive. The name *Iris* derives from the ancient Greek word for rainbow; and just as gorgeous hybrids come in a rainbow spectrum of colors, so do many wild species. Even more variable than flower color is the infinite variety of flower form and growth habit. For example, in eastern Europe *Iris pseudacorus* L. grows over two meters tall along a streamside; while nearby a steep hill might be carpeted with mats of yellow, purple and blue dwarf bearded iris barely three inches tall. The wild blue flag, *I. versicolor* L., can grow four feet tall near mats of prostrate crested iris, *I. cristata* Solander, or vernal iris, *I. verna* L., which form extensive carpets in eastern woodlands of America.

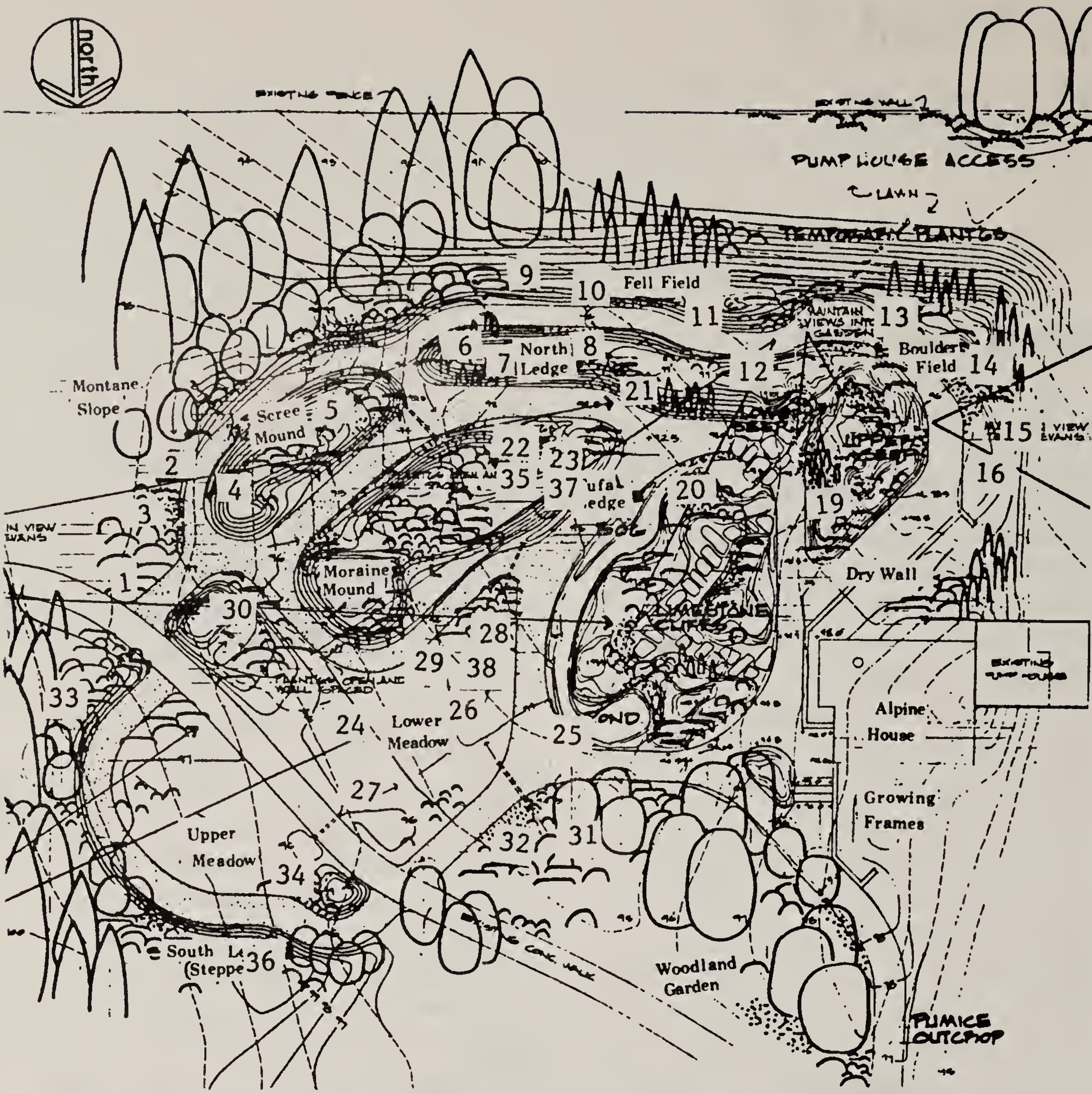
Wild irises are not limited to Eurasia and eastern United States. What Colorado wildflower lover has not delighted in finding our native Rocky Mountain iris filling a mountain valley or broad parkland with its limpid blue pools of color?

The Rocky Mountain iris, *I. missouriensis* Nutt., named for the river along which it was discovered, is the only iris that occurs naturally throughout the extensive Western Intermountain Region, the Rocky Mountains and the High Plains. In Colorado it occurs from the lower fringes of the foothills zone to the upper limits of the tree line. This wild iris is one of the few native wildflowers that has probably increased its acreage since the advent of white man. Cattle and sheep avoid eating its toxic foliage; as a result overgrazed pastureland often presents glorious displays of this lovely flower.

Interesting color variations of the Rocky Mountain iris, including albinos and a deep purple clone, have been selected to grow in the Rock Alpine Garden. This garden was conceived as a place where plants adapted to stressful environments such as alpine tundra, desert, cliff and bog could be tamed in a garden setting. Only a handful of wild irises are adapted to arctic and alpine environments, but many species grow on the high, dry plains of central Asia. Most of these are

---

Panayoti Peter Callas, Curator of the Rock Alpine Garden at Denver Botanic Gardens, has been growing species iris in his own garden from the time he was a child. He is a member of the Species Iris Study Group of the American Iris Society and a contributor to its publication, *Signa*.



Rock Alpine Garden at Denver Botanic Gardens
*Numbers indicate general location of iris species with corresponding numbers in text.

truly dramatic in growth form and flower color; and some are being grown in the Alpine House and on the dry steppe portion of the Rock Alpine Garden adjoining the Plains Garden. Most irises, however, are woodland or streamside plants from climates with moderate rainfall.

At present approximately seventy species of irises are growing in the Rock Alpine Garden. Let's take a casual walk through the garden located in the southwest corner of Denver Botanic Gardens and preview its beauty in the coming months. We will have to rush a bit, for the season of wild iris bloom is rather long; most years reticulate irises will bloom in February and the vesper iris not until August.

As we enter the garden to the left we will see several of the crested irises (section *Lophiris*). We are confronted with *I. tectorum* Maxim. (1)* in both the blue and white forms. A vigorous and carefree plant in Colorado, it is found in many local gardens where it will thrive under most any garden regimen. Called the Japanese roof iris, since early travelers to Japan reported that it grew on the thatched huts of those islands, botanists believe it is actually Chinese in origin. A close relative is *I. japonica* Thunb., a lush, evergreen species which produces long panicles of pale, frilly, orchid-like flowers. This iris, too, is apparently Chinese in origin,

although it currently occurs spontaneously throughout most of the lowland regions of Japan. The clue to its origins is the fact that this Japanese crested iris never produces viable seed in Japan. The millions of plants throughout the islands apparently originated from a single, sterile importation. Unlike the hardy roof iris, it is only marginally hardy in colder regions.

As we continue along this **montane slope,** with its woodsy soil and shade from young paperbark and amur maples, we encounter another crested iris. This is *the* crested iris, *I. cristata* Solander (2) in three color forms, that has woven an almost impenetrable mat under these trees over the last two growing seasons. Its low leaves are broad and pale green, forming a lovely groundcover in summer. This is fortunate, for the flowers are often criticized for being ephemeral. The crested iris invariably blooms during the two or three week rainy season Colorado seems to have perennially in May. During these weeks, there is an almost constant progression of the striking, flat flowers that have an icy, translucent color in the blue forms and an ivory texture in the albino. The eastern crested iris has proven a good plant for a variety of sites in Colorado gardens but needs a certain amount of hand weeding and replanting every three or four years to maximize blooming.

Several robust clumps of *I. graminea* L. (3) occur in the background of the **montane slope.** Few visitors can enjoy the flowers, but it will reward those who seek them out buried deep in foliage, for the waxy spuria blossoms smell exactly like a ripe plum. Although rather widespread in the eastern Mediterannean region it adapts to a surprising variety of sites in local gardens blooming in late May. It tolerates full sun in rich soils even managing to grow in full shade if provided with adequate moisture.

A number of unusual, inter-sectional hybrids occur along the path from here to the summit of the garden. These are the so-called "Cal-Sibes", hybrids between the Pacific Coast irises (series *Californicae)* and Siberian irises. All of these hybrids were produced by Jean Witt of Seattle and appear to be vigorous in Colorado. They possess the lustrous, glossy, semi-evergreen foliage of California irises with the vigor of Siberians. The hybrids you will see include 'Fine Line', 'Summerland' and 'Velvet Pennant'.

Looking to the west of the path at the **scree mound** opposite the **montane slope,** you will notice several species of dwarf bearded irises, that supreme section of the genus for rock gardens. The dwarf bearded irises are the most prevalent wild iris in southern and eastern Europe, where they occur from the higher elevations in Greece, Italy and southern France to the very margins of the Mediterranean Sea. A number of species have been planted throughout the

***Iris gatesii,* An *Oncocyclus* Iris**

Rock Alpine Garden, beginning with the tiniest of bearded iris, *I. sauveolens* Bossier & Reuter (4) which occurs in a variety of colors and sizes throughout the Mediterranean basin. This iris can be distinguished from other dwarf bearded iris by its tiny stature and sickle shaped leaves, and by its difficulty of cultivation. *I.reichenbachii* Heuffel (5) grows a little further along on this same mound. Much larger in size and more robust, it forms sizable patches in a brief period of time. Primarily Balkan in distribution, this dwarf bearded iris blossoms in a wide range of yellow and purple tints. Our plant is a bronzy yellow-flowered form which will grow under various conditions in cultivation.

Moving onto the **fell field** and the **north slope** we come upon *I. setosa* ssp. *canadensis* (M. Foster) Hulten (6), a reputedly dwarf variety of the Labrador iris although it is only six inches or so smaller than the Alaskan forms. This subspecies is prevalent in Labrador and extends to northern Maine on the eastern seaboard. *I. setosa* Pall. ex Link is one of the most widespread of irises, occurring in Siberia, northern Japan and most of the arctic reaches of North America. While the Labrador iris has been in the garden for only two years, each clump produces dozens of flowers over a six-week period. It is sure to attract attention in June, as it overlaps with tall bearded irises in blooming period. The smoky, gray-blue flowers are not nearly as showy as the Alaskan form of the same iris found further along this slope; but to sophisticated tastes, a clump of Labrador iris in bloom is second to none.

Another few paces along this slope grow some robust plants of *I. bracteata* Watson (7), one of the lesser know native American irises belonging to the series *Californicae.* It is reputed to be a difficult plant to grow in many parts of the United States, but given an acid soil rich in humus with a sunny exposure and mulched with pine needles this has proven a reliable garden plant in Colorado. It has lustrous, evergreen foliage of a very waxy and almost succulent texture. The orchid-like yellow blossoms are produced in pairs in late May and June—lasting for several weeks on an established clump. Unlike bearded iris, the Pacific Coast native irises do not like to be disturbed. In our climate, a clump can persist for several decades without needing division.

Further along the same side of the **north slope** is one of the greatest prides of the garden, a large bed smothered with *I. ruthenica* Ker-Gawl. (8) This unusual little iris has been found sporadically from eastern Europe all across Eurasia to the Pacific Coast, occurring in a bewildering variety of sites and climates. In our area it seems to grow well in any good garden soil in part shade or sun, forming huge mounds of grassy foliage with an amazing profusion of miniature, jewel-like flowers throughout most of the month of April. In wet climates, the Ruthenian iris can go years without blooming. In Colorado it is a showpiece.

Across the crushed limestone path on the **fell field,** *I. lacustris* Nutt. (9) has formed a number of dense, diminutive mats. This is one of the tiniest wild irises, rarely exceeding two inches. In nature it was largely restricted to woods and meadows around the margins of the Great Lakes, but vacation home development has almost wiped out this small American wild iris. A difficult plant to grow requiring

moisture, lime and humus, it thrives here along the path producing dozens of miniature, sapphire renditions similar to its close relative, *I. cristata.*

Further west along this same slope one can find several large clumps of *I. minutoaurea* Makino. (10), another miniature iris. This one comes from Manchuria and Korea and belongs to the little known series *Chinenses* of the genus *Iris.* It also produces tiny, jewel-like flowers, but of a pale yellow color, among the grassy tufts of leaves.

I. kamaonensis Wallich *ex* D. Don (11) is the last tiny iris one encounters on this side of the path. This almost mythical iris is named for the Kamaon or Kumaon region of the western Himalaya, where it can be found up to 15,000 feet in elevation. It is regarded as one of the best of the series *Pseudoregelia* irises, the highest alpine of all iris species. They form low, blunt-leaved mounds of foliage and produce their strange flowers early in spring. These flowers are usually pale blue, blotched with a bizarre pattern of pink, white and deeper blue.

Iris enthusiasts are invariably surprised and pleased to see how well *I. verna* L. (12) has taken to cultivation in Colorado. In our garden it grows along the crown of the **north slope** just above the waterfall, forming dense mats of glossy, deep green leaves that bronze considerably under our winter sun. Nevertheless, this eastern woodland iris seems to grow far better here in sun with acid, peaty soil than under any other regimen. It blooms and grows prolifically here.

Around the bend in the path at the summit of the garden, clumps of the native Alaskan *I. setosa* grow along the streambank. There are a variety of Pacific Coast native irises growing on the west side of the path, including the yellow form of *I. tenax* var. *gormanii* (Piper) Foster (13) which was once very rare in the Coast Range of Oregon. As more and more of the mountains around Portland were clear-cut, this once rare iris emerged from long-buried seed in ever increasing abundance so that it is now regarded as relatively common. This grassy-leaved iris produces dense tufts of foliage and very large flowers, sometimes five inches across, of a pale, lemon-yellow tint.

Another yellow-flowered Oregonian can be found further down the slope. *I. chrysophylla* Howell (14), produces many blue-grey or silvery leaves and spidery flowers of a straw-yellow or creamy tint. This is regarded as one of the more temperamental and temporary Pacific Coast irises, although it has persisted with undiminished vigor more than seven years in Colorado.

I. douglasiana Herbert (15) has grown even longer in a number of local gardens. In nature it is restricted to the narrow fog-belt of the Pacific Coast. It has grown for over 15 years in Allan Taylor's Boulder garden. A number of plants have been established here in the Rock Alpine Garden. It is a rather variable iris with three or four inch wide flowers blooming in June above the deep green, winter-persistent foliage.

On the back side of the **boulder field,** a large clump of *I. milesii* Foster (16) from China has been established. This is the largest of the hardy crested irises, but one of the least known in cultivation.

Other native irises have been established along the northern slope of

the **upper seepage area.** *I. tenax* Douglas *ex* Lindley (19) in its most common blue and purple forms is growing among a variety of ericaceous plants on this peat bank. This most common "Oregon" iris is one of the loveliest wildflowers of the Willamette Valley. It is probably the hardiest of the Pacific Coast irises, since it is deciduous.

***Iris tenax*, A Pacific Coast Iris**

Presently, the only iris growing on the **limestone cliffs** is the unusual vesper iris, *Pardanthopsis dichotoma* (Pallas) Lenz (20) which was included in the genus *Iris* for many decades. Iris-like in shape, each flower lasts only a day, opening only in the late afternoon and closing shortly after dawn most summer mornings, so only a few nocturnal insects enjoy its beauty. This strange iris from northern China and Manchuria blooms not only late in the day, but also late in the year, rarely starting to blossom until late July.

On the shady side of the **north slope** grow large clumps of *I. gracilipes* A. Gray (21) in the blue, white and strangely contorted double form. Sometimes described as the most delicate of irises, it forms a graceful swirl of wispy leaves and a cartwheel of wiry stems with the prismatic inch and a half blossoms quivering atop the clump during most of May. This rare Japanese iris requires shade, drainage, humus-rich soil and moisture throughout the growing season, but once established it is permanent and one of the loveliest of rock garden plants.

Opposite, on the **moraine mound,** are several unusual bulbous irises. *I. reticulata* M. Bieb. (22) pierces mats of *Herniaria glabra* L. and *Paronychia kapela* (Hacq.) Kerner in early spring. These dazzling early spring bloomers, rarely grown by local gardeners, will grow vigorously in a variety of sunny sites in a Colorado garden and are available from local garden shops. Even more striking, perhaps, than *I. reticulata* is *I. histrioides* (G.F. Wilson) S. Arnott var. *major* Grey (24) which also blooms in late winter most years and belongs to the same section of the genus. The flowers in this Turkish iris are sometimes five inches across, and emerge before the leaves pierce the ground. They last remarkably well for weeks on end and through snowstorm after snowstorm.

The juno irises have captivated the imaginations of gardeners from the time that Thomas Jefferson first grew *I. persica* L. at Monticello. Bulbs of this fabulous, sea-blue winter iris are still grown by gardeners; although, regrettably, we have none at the Rock Alpine Garden. Other junos obtained from England can be seen in the Alpine House this spring. One has established itself as a superb rock garden plant; *Iris bucharica* Foster (23) resembles nothing so much as a miniature corn plant with Dutch iris blossoms pinned to the leaf axils. The form growing on the **moraine mound** is bright yellow in color, and more dwarf in stature than most *I. bucharica* cultivars. In England this iris often exceeds two feet in height, and ranges from yellow to pure white in color.

***Iris bucharica,* A Juno Iris**

The only iris growing along the stream below the waterfall is *Iris ensata* Thunb. (25) grown from seed collected in the wild in Japan. This striking iris has deep purple, yellow-splotched flowers which are much more graceful than its huge flowered "Kaempferi" progeny.

To the north of the **moraine,** the **lower meadow** forms a large flat expanse, a pleasant contrast to the rest of the garden's rocky terrain. The simulated stream bisecting the meadow is bordered with several irises and iris relatives. Let's meet them. Clumps of a strange Siberian iris, *I. sibirica* L. (38), grown from seed originating near Brno, Czechoslovakia bloom in late June with coarsely reticulated blossoms. Several large clumps of *I. lactea* Pallas (26) occur along the bank further up the stream. This is one of the most tolerant and adaptable irises that grow in Colorado gardens. The form growing here closely resembles our native *I. missouriensis.* except for its white falls, blue standards and an unforgettable cigarette-lighter fluid aroma. The leaves are far more persistent than our native iris, remaining green and firm well into autumn. It makes a tremendous show for much of May and early June, and seems to thrive in almost any soil or exposure in our climate.

I. missouriensis (27) is found further up in a number of different color forms, from deep blue and purples selected by Allan Taylor from populations near Boulder, to three separate albino clones from three different western states. Other irises growing around the meadow include the dwarf bearded species *I. x barthii* Prodan (28) and *I. furcata* M. Bieb. (29). *I.*
flavissima Pallas (30) flourishes on the warm bank at the top of the **meadow.**

The northern portions of the Rock Alpine Garden are especially suited to dryland irises such as the arils and junos. Here the soils vary from sandy loams to heavy, alkaline clays with a long summer baking among the **limestone cliffs.** The first year after planting, *I. hoogiana* Dykes (31), *I. hoogiana* 'Bronze Beauty' (32), *I. stolonifera* Maxim. (33), and *I. hoogiana* 'Purpurea' (34) produced dozens of flowers. In another year the display should be even more impressive. Other aril irises in the garden include *I. gatesii* Foster (35), *I. iberica* Hoffm. (36) and *I. polakii* Stapf. (37).

This synopsis is just that—a recapping of some of the more noteworthy irises in the garden. Dozens more have been planted from seed this year, or simply have not been tried yet. Herb Schaal, in designing the Rock Alpine Garden at Denver Botanic Gardens, wished to provide the proper soil and drainage, and have efficient watering regimens so that the broadest range of hardy plant material could be grown on this acre of ground. In order to find out just how successful this vision was, we invite you to come by and visit.

Siberian Irises At Denver Botanic Gardens

Harry B. Kuesel

The Siberian irises comprise a group of beardless species which are native in moist meadows found in low and mountainous regions of central Europe and Asia. Two of the species, *Iris sibirica* L. and *I. sanguinea* Hornem. *ex* Donn. (sometimes called *I. orientalis* Thunb.) have 28 chromosomes each. The other eight belong to the subseries, *Chrysographes,* and have 40 chromosomes each. Through the use of colchicine, Dr. Currier McEwen and others have been able to convert the 28 chromosome varieties to tetraploids with 56 chromosomes each. Professor William G. McGarvey has successfully crossed the two series and named the best one 'Foretell'. This is a nice yellow with purple flecks on the falls and pale blue standards and styles.

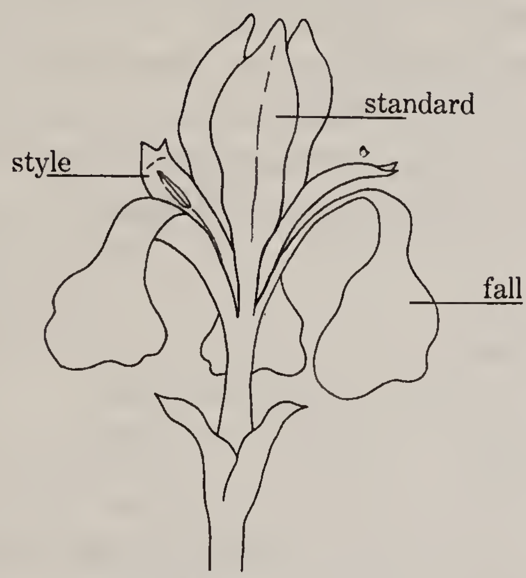
The present Siberian iris collection at Denver Botanic Gardens is located in a large semi-circular bed northeast of the main iris display gardens. Jack Riley and the writer collected and planted some 30 different varieties in 1974. At that time they were given the same type of soil preparation before planting as was used for tall bearded irises except that we added a few handfuls of peatmoss per clump in the bottom of each planting hole. We planted some of the species and many hybrids, both diploid and tetraploid. The results were good but bloom was not spectacular. Our problem was that they were planted in a naturally alkaline soil. About this time, Harlan Clark persuaded me to build an acid bed at my home garden to grow Japanese irises. I dug a large kidney shaped hole about 4 feet by 8 feet in size and 2 feet deep and lined the hole with heavy sheets of flexible plastic. I filled this with an acidic soil obtained from a mountain meadow which Mr. Clark had discovered. In addition to the Japanese irises, I decided to plant a few Siberian irises in this new acid bed. The results were that the Siberians planted in the acid bed grew much better and the bloom also was more floriferous. So we have taken steps to acidify the Siberian iris planting at Denver Botanic Gardens with the addition of agricultural sulfur.

Most of the species we planted have not done as well as the hybrid varieties, probably because the 40 chromosome kinds, prefer year round moisture in their natural habitat, so we plan to move them to the Rock Alpine Garden. One exception is *I. bulleyana* Dykes. This has only two flowers per stem but many stems per plant. The flowers have short narrow blue-

---

Harry B. Kuesel is Vice President of the Society for Siberian Irises and has been a trustee of the Denver Boatnic Gardens since 1973. He has been instrumental in establishing the Hemerocallis (daylily) and Siberian Iris Display Gardens at the Gardens.

purple standards, small oval blue-violet falls with deeper veins and a cream base ground color. Styles are dark violet-blue held high above the falls. (See illustration). There is no other Siberian quite like it and it has long been one of my favorites.



Siberian Iris Flower

Siberian foliage exhibits a wide range in form and position reflecting differences inherited from the parent species. It may vary from very narrow to quite broad and from stiffly erect to foliage that bends at the top producing a fountain effect in the clump.

Diversity of form in Siberian irises is highly desirable. The Society for Siberian Irises has made diversity as opposed to the single "best" form a guiding concept. The flowers should, however, always give the appearance of being light and graceful.

The range of color in Siberians is not as broad as their tall bearded iris cousins. Presently they can be found in white, yellow, pink, red, violet, blue-purple and black, and many shades in between. Hybridizers are developing new improvements annually so we may have more colors before long.

Each year, judges of the American Iris Society vote for the Siberian iris they like best among all they have seen blooming in gardens across the country. The iris with the most votes is given the Morgan Award in honor of Cleveland Morgan, a pioneer Siberian iris hybridizer. Denver Botanic Gardens is fortunate to have most of the Morgan award winners. The winner in 1981 was 'Butter and Sugar' (McEwen), a unique yellow amoena with semi-erect standards in white, arched yellow falls with greenish yellow veins, white styles and midribs. Earlier winners were: 'Ruffled Velvet' (McEwen), with upright, extremely ruffled, reddish-purple standards, ruffled darker reddish pansy-violet falls, and purple styles laced and feathered; 'Augury' (McGarvey), one of the first ruffled pinks with falls a shade deeper than the standards, the pink fading to light orchid as the flower ages, but always remaining attractive; 'Silver Edge' (McEwen), a lightly ruffled larger medium blue with a distinct silver edge around the falls, a yellow-white blaze in the center, blue styles and a turquoise midrib; 'Vi Luihn' (Du Bose), a deep violet self with a pale yellow signal;

Iris bulleyana

'Orville Fay' (McEwen), the first Siberian tetraploid introduction with medium blue standards, wide flaring falls and fine branching; 'Halcyon Seas' (McCord), deep blue standards and violet blue falls; 'Grand Junction' (McCord), a vigorous blue bi-tone with white markings; 'Swank,' a deep blue self with a small yellow signal; 'Ego' and 'Super Ego' (both by McGarvey), two fine blues, the former with lots of ruffles and an interesting haft pattern, the latter a very distinctive light blue with a deeper center.

The American Iris Society will come to Denver this year for its annual convention. Many hybridizers have sent their newest creations to the Gardens for evaluation. Last year I had an opportunity to see many of these guest plants and saw many new improvements. 'Kismet' (Varner) is a fine deep red-violet, perhaps the reddest to date. 'Wing on Wing' (McGarvey) is a glistening pure white against a deep sky-blue. 'Reddy Maid' (McEwen) is a rich velvety reddish-purple with very large flowers. 'Pink Haze' (McGarvey), perhaps the best pink amoena to date, was most impressive. Many other guests will bloom for the first time in 1982.

References

Edwards, Margaret, Ed. *Semi-Annual Bulletins.* New York: The Society for Siberian Irises.

McEwen, Currier. 1981. *Siberian Irises.* New York: The Society for Siberian Irises.

Warburton, B. and M. Hamblen. 1978. *The World of Irises.* Wichita, Kansas: The American Iris Society.

One Of A Kind—*Sisyrinchium bermudiana*
Bermuda Blue-eyed Grass

Andrew Pierce

How perplexing is the group of plants called *Sisyrinchium,* members of the Iris family! No wonder many botanists have been put awry by the multitude of names of the genus.

This genus of perhaps 75-100 species, many of them called blue-eyed grass, is distributed throughout many areas of the new world. The taxonomy of the group is confusing, due in part to the intergradation of characters used to define the species. The new *Gray's Herbarium Index,* for example, lists some 12 forms and varieties of *Sisyrinchium bermudiana* L. This species is an isolated group inhabiting that small—21 square miles—group of islands, the Bermudas, situated in the North Atlantic Ocean.

Just one year ago the Denver Botanic Gardens tour group visited the islands and questioned the relationship of our native blue-eyed grass with the Bermuda blue-eyed grass.

Andrew Pierce, Assistant Director of Denver Botanic Gardens, was a resident of Bermuda for 13½ years, and is an avid wild flower "hunter". He led the Denver Botanic Gardens tour to Bermuda in 1981.

Alice Eastwood, in her *Popular Flora of Denver* (1893), lists one blue-eyed grass, *S. mucronatum* Michx., found along the Platte River but not common. This name does not appear again in most Colorado flower manuals. The common species which occurs in the Rocky Mountains here, ranging from 4000 feet to 10,000 feet in elevation, is listed in local floras as *S. montanum* Greene. Dr. H.D. Harrington, in his *Manual of the Plants of Colorado* (1954), adds another four species all of which he classifies as uncommon.

Sisyrinchium bermudiana is a small perennial with grass-like leaves growing 8-12 inches tall. The little clusters of violet blue flowers with contrasting yellow eyes open during the sunlight hours of late April until the end of June. It is a common inhabitant, principally of sandy locales, on the islands and cannot be considered endangered.

First records point to a specimen placed in the Sloane Herbarium of the British Museum of Natural History in 1699 by one J. Dickenson. Carl Linnaeus considered *S. bermudiana* to be typical from those islands, not occurring naturally in other areas of North America. For many years the plant was believed endemic, an idea shared by Nathaniel Lord Britton, a former Director of New York Botanical Garden, as stated in his *Flora of Bermuda* (1918). Over the past two decades controversy has arisen concerning its identity. Some botanists questioned whether the species is, in fact, endemic to Bermuda, suggesting that it is *S. angustifolium* Mill., a species of the eastern coast of North America. Britton and others felt that *S. bermudiana* had more affinity with species that come from Mexico and northern areas of South America.

Sisyrinchium bermudiana

Such happenings gained the attention of Dr. L. Michael Hill of the University of Bridgewater, Virginia; who, amongst his interests, studied this species from a cytololgical standpoint. In testing *S. bermudiana,* Dr. Hill found it to have 64 chromosones, a number different from all other species in the genus. No doubt, through isolation the plant has differentiated and, consequently, not only is it endemic; it is unique among blue-eyed grasses. Bermuda can be proud of its national flower which unfortunately is not hardy at Denver Botanic Gardens.

We have to be content with the closely related *S. alatum* Hook. which can be found in the perennial borders during the summer. We had the very distinguished yellow *S. striatum* Smith for a few years until it succumbed and have recently tried *S. brachypus* Henry and *S. convolutum* Nocca in the Rock Alpine Garden.

When you are in the foothills or lower mountains this summer keep your eyes open and if the sun is shining, you may spot our local blue-eyed grass, *S. montanum,* which, though common, often goes unnoticed due to its diminutive habit.

A Gift of Roses

Josephine Robertson

Mother Irene of St. Anne's School in Denver found it hard to pick a favorite among the beautiful roses she tests for Jackson & Perkins, but, pressed to choose, named 'Honor,' the white hybrid tea, selected 1980 Rose of the Year and All America Rose Winner. In August, loaded with large, pure white flowers, it grew shoulder high and was in its third blooming.

A member of the Episcopal Order of St. Anne's, Mother Irene organized the school on behalf of the Order in 1950. Today it enrolls more than two hundred boys and girls through the eighth grade. Though a native of Vermont, she grew up on Long Island with a love of flowers because that was the spare time hobby of her engineer father. She holds Bachelor's and Master's degrees from New York University, and for many busy years of teaching had no time for the flowers she enjoyed. Now in her eighties she confines her own teaching to remedial reading.

The rose chapter of her life began ten years ago. She was recuperating from a serious illness when some friends, instead of sending flowers, gave her five rose bushes to plant and tend. An inspired gift . . . a new interest. Someone suggested her name to Jackson & Perkins for testing and this makes her hobby even more rewarding.

Each April the growers send her four or five strong bare root bushes with numbers, not names. She is ready for these ahead of time with holes dug and soil mixed with dry manure. The new stock is soaked in water for twenty-four hours and the hole is watered. In the bottom there is a small mound over which she spreads the roots carefully, trimming any that are damaged. In six weeks there are leaves and, by the end of May, flowers. She fertilizes in early spring with more manure or Ortho Rose Food and again after the first blooming. After the first frost she mulches with shredded leaves and grass clippings.

Her obligations consist of filling out a form for Jackson & Perkins, on such points as date of first leaves, shape and quality of foliage, fragrance, strength of stems, color retention, heat resistance and how well the flowers last after cutting. The varieties that produce good reports from the many test growers are named and offered the next

---

Josephine Robertson, a graduate of Columbia University School of Journalism, has authored nine inspirational books published by Abingdon Press, as well as numerous articles for national and local periodicals.

year commercially. Some are tested a second year; some don't go to market at all. Mother Irene now has a collection of about forty thriving bushes. Hers is not a formal garden. There is neither time nor help for that sort of weedless display, but tucked here and there in an informal setting the roses look distinctly happy. Among them are the two other 1980 top winners, 'Love,' a red grandiflora and 'Cherish,' a shell pink floribunda. Other favorites are 'Oregold,' 'Madras' and 'New Day.'

Mother Irene is pleased to be a member of the Denver Botanic Gardens and glad that her pupils have the opportunity to visit the Gardens on guided tours.

"Rose growing," she says, "is a very rewarding hobby. Roses are not very expensive, are not too demanding and last a long time. I have found that working with them is wonderful therapy and a great pleasure—and part of the pleasure is being able to share them with others."

Mother Irene in Rose Garden

Exotics of Colorado Squill, *Scilla sibirica*

Helen Marsh Zeiner

One of the earliest of the spring-flowering bulbs, the squill, *Scilla sibirica* Andr., brings a welcome touch of bright blue to an otherwise drab garden. Depending on the season, squills may bloom as early as March. They withstand snow well, and will come from under a snow cover with little or no damage. Perhaps they are at their most charming when they are surrounded by snow.

The bright blue flowers are sometimes described as delphinium blue or sky blue, but it is the blue of the bluest Colorado sky. Too small to be showy as individual flowers, clumps of squills together with snowdrops and early crocuses, add color before tulips and larger bulbs begin to bloom.

The flowers, usually about ½ inch across, are borne on leafless scapes 3 to 6 inches high. Usually there are three flowers per scape, each short pediceled and arranged in an open terminal raceme. Each bulb usually produces one to six scapes which overtop the long, narrow, lanceolate leaves, ¾ inch or less broad. Each bulb produces two to four ascending leaves.

Scilla sibirica is sometimes confused with *Chionodoxa luciliae* Boiss., glory-of-the-snow. This is another small blue-flowered bulb blooming about the same time as the squill. *Chionodoxa* has a short perianth tube; in *Scilla sibirica* the segments of the perianth are distinct or nearly so. (The calyx or sepals and corolla or petals together constitute the perianth.) In *Scilla* and *Chionodoxa* the sepals and petals are colored alike so that all segments of the perianth are blue. *Chionodoxa* has bright blue flowers with a white center; those of *Scilla* lack the white center. The two genera, *Scilla* and *Chionodoxa,* are closely allied genera of the lily family, *Liliaceae.* Hybrids between the two genera are known and are classified as *Chionoscilla.*

The genus *Scilla* contains about 80 species, widely distributed in Europe, Asia, and Africa in temperate districts. *Scilla sibirica* is native to Russia and Asia minor, but not Siberia as its name might indicate.

Several species of *Scilla* are cultivated as garden flowers. One of the most popular is *Scilla nonscripta* Hoff. and Link., the wood hyacinth. Blooming in April or May, this *Scilla* puts up spikes of hyacinth-like flowers in shades of blue, white, lilac, and pink. Recently *Scilla violacea* Hutchinson, with interesting mottled fleshy leaves, has appeared on the house plant market.

Helen Marsh Zeiner, Ph.D., Curator of the Kathryn Kalmback Herbarium writes "Exotics of Colorado" as a regular feature of *The Green Thumb.*

Scilla sibirica is useful in borders, in rock gardens, and for naturalizing. Naturalized in the grass of lawns, it can grow undisturbed for years, but it does need some feeding. The squill can be grown successfully under shrubs, since it blooms and matures before the leaves are formed enough to make the site too shady. Squills will grow in any good garden soil. Bulbs should be planted early in the fall, about 2 inches deep according to size, and spaced an inch or more apart. In a border or bed, it is advisable to lift and divide the bulbs every three or four years. Squills increase from self-sown seeds and offsets.

Squills can be forced for indoor use. Plant 5 or 6 bulbs in a 5 inch pot of good potting soil, and give them a long period of root development in a cold place.

Scilla is an old Greek name used by Hippocrates. It is said to mean "I injure", alluding to poisonous properties of the extremely acrid bulbs. A plant of the Mediterranean region known as Urginea squill or sea onion, has been used medicinally from earliest times. "Syrup of squill" for the treatment of colds and croup is a very old remedy. There is some question about the taxonomy of this plant. It is sometimes listed as *Scilla maritima* Steinb., but now is usually classified as *Urginea maritima* Baker. The confusion over its proper classification might well indicate that the plant needs further study.

References

Bailey, L.H. 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

DeBoer, S.R. 1948. *Around the Seasons.* Denver: The Smith-Brooks Press.

Squill, *Scilla sibirica*

1981 Rocky Mountain Regional Rare Plant Conference

J. Scott Peterson

"Energy Development and Rare Plants: Planning for the Future," was the theme of the 1981 Rocky Mountain Regional Rare Plant Conference held at Denver Botanic Gardens November 5 and 6. Approximately 200 persons from 10 western states attended, representing a wide range of interests, from industry to the interested layperson.

The two day event was organized by the Colorado Native Plant Society and cosponsored by the Denver Botanic Gardens, National Park Service, U. S. Fish and Wildlife Service, the native plant societies of Utah, Wyoming, and New Mexico, and the Association of Western Native Plant Societies.

Carolyn Johnson, of the Natural Resources Defense Council (NRDC), spoke on the status of plants under the Endangered Species Act (ESA), reviewed the performance of the U.S. Fish and Wildlife Service as the lead agency under the ESA, and commented on the reauthorization of the ESA that will come before Congress this year. She was discouraged that the new requirement that agencies confer regarding the likely impact of projects on proposed species has not been fully implemented.

Ms. Johnson also told of numerous amendments under consideration to weaken the protective provisions of the ESA, such as the regulation of interstate commerce in listed taxa and the prosecution of such offenses. The impact on certain plants, especially horticulturally valuable cacti, which are threatened by overcollecting, might be severe.

Reauthorization of the ESA in a form that would offer protection to plants will be a major struggle. The NRDC and several conservation organizations have formed a loose coalition to work for a strong bill to include continued eligibility for protection for all taxa, a continuation of Federal-State coooperative programs, and prompt listing of taxa on the basis of their biological status and commercial exploitation.

Larry Thompson of Montana stated that Montana contains a high floristic diversity but has been the subject of relatively little botanical study. One of the major problems is the lack of a recent, comprehensive flora or a state list of rare and endangered plants, although an effort to compile a state list is underway.

Though Montana, like Colorado, has no state regulations specifically offering protection for rare plants, their statutes imply protection. The acts are the Montana Environmen-

---

J. Scott Peterson is Coordinator/ Botanist of the Colorado Natural Heritage Inventory, a DBG member, and contributor to *The Green Thumb*.

tal Policy Act of 1971, the Montana Major Facility Siting Act of 1973, and the Montana Strip and Underground Mine Reclamation Act of 1973. An environmental factor that must be considered under the Siting Act, is the "effects on plant and animal life" and "effects on unique or otherwise significant ecosystems." If a federally classified or otherwise recognized rare or unique plant were to be discovered in a project area, the Siting Board would have these options: 1) grant the siting certificate and damage the population, 2) deny the certificate, or 3) grant a conditional certificate requiring modifications to the proposed facility, impact mitigation, or restoration or reestablishment of plant communities. To date, rare plants have not been an issue.

The Reclamation Act specifies "that certain lands, because of their unique or unusual characteristics may not be strip-mined or underground mined in any circumstances," and that a permit shall not be issued for "land having special, exceptional, critical, or unique characteristics." This section has been invoked only four times in the history of the Act, though none of the cases involved rare plants.

William A. Weber, Ph.D., Curator of the Herbarium, University of Colorado Museum, considered "The Real Data Base, and the Flora Manual." He expressed concern about the vegetation surveys that are occurring today in conjunction with development—particularly uncoordinated surveys resulting in a duplication of effort, surveys resulting in only sight reports, poor quality specimens, and most importantly, surveys that are conducted with none of the specimens being deposited in a recognized, scientific herbarium—the real data base.

Dr. Weber pointed out that whole collections are not always submitted for verification, and the ecologist, unwisely, may choose not to submit specimens about which he or she is confident of a correct identification. For instance, Dieter Wilken, Ph.D., at Colorado State University, had shown him a plant from the Piceance Basin which has consistently been passed over for *Aquilegia barnebyi* Munz, and had not been examined for flowers and fruit. This plant, in fact, was an undescribed endemic species of *Thalictrum* L.

Dr. Weber urged impact ecologists to request at least one full season for surveys, to collect at least one excellent specimen of each species encountered, and that the first set of specimens be deposited at a recognized herbarium for review by a professional taxonomist.

Mallow Family Species: A Plate from Dr. Weber's Upcoming Flora

Dr. Weber then commented regarding his in-progress writing of two complementary handbooks to provide coverage of Colorado flora. He is committed to generating manuals that are affordable and easily handled in the field. Thanks to a bequest by Katharine Bruderlin Crisp of Denver, Dr. Weber purchased a word processor, enabling him to produce a manual manuscript. He is now approaching industry, foundations, and individuals for contributions to subsidize the art work ($200 per plate) and the final publication. If you would like to contribute to this needed and worthwhile project, please contact the University of Colorado Development Office.

Speaking on "Business and the Botanist," Patricia Rand, Ph.D., of the Atlantic Richfield Company caused everyone to sit up and take notice. Her remarks were based upon the following four premises: 1) change is the universal order of life; 2) despite natural comings and goings of species, people have an ethical obligation as well as the absolute necessity of sharing living space on earth with the multitudinous forms of life, which have evolved through time and upon which our survival depends; 3) industry, as a part of society, must share the burden of caring for earth's inhabitants; and 4) if we are losing the fight to save endangered plant species, we are doing so because we have failed in the marketplace and the halls of the money changers, to convey the importance of plants.

Dr. Rand stated that the major difficulty in bringing about consideration for rare plants is the fundamental lack of adequate education and communication between botanists and the world at large, including industry. To communicate, individuals must speak the same language. If the world won't learn ours, then we must learn the world's.

The botanical message, indicated Dr. Rand, is more powerful than any that other biologists tell. Without plants, neither birds, nor fish, nor bear, nor human beings themselves can survive. So what language must we speak to be understood? According to Dr. Rand, one must speak a jargon recognizable by engineers, for it is they who control the company fortunes, abetted by the business administration majors and a smattering of geologists.

In Dr. Rand's words, "Why would we be surprised that engineers and miners don't understand our language? We don't teach them the grammar, but we expect them to translate at complicated levels. The understanding of principles and their application in the living world is the ingredient that professional biologists must supply the world." Simply, though effectively put, Dr. Rand suggested that we each take an engineer to lunch today.

Bush Cucurbits for the Urban Vegetable Garden

David Savory

The Cucurbitaceae (Gourd family) is one of extreme horticultural importance and has been since Biblical times. Cucumber, muskmelon, pumpkin, squash and watermelon are among the most well known cucurbits, some of which are found in nearly every vegetable garden.

Their origins seem to be as varied as the size and shape of these vegetables. The cucumber originated in India and has been cultivated there for at least 3000 years. Muskmelons, as well as watermelons, have their "roots" in Africa and can be traced back as much as 5000 years. Pumpkins and squash are both distinctly American vegetables being native of Central and southern North America. Southwest American Indians grew them long before any European settlers arrived.

The Cucurbitaceae are all quite similar in appearance having prostrate, sprawling vines usually bearing tendrils. The large leaves are palmately lobed or dissected and are arranged alternately on the stem. Both male and female flowers are mostly yellow and the fruit is a fleshy berry-like structure known as a pepo. Down through the years plant breeders have made some changes in their appearance. Efforts have been focused largely on altering the size, taste or quantity of the fruits. More recently breeders have been developing vegetable varieties with more subtle improvements such as disease resistance, drought tolerance and space requirements.

The most obvious disadvantage of cucurbit crops from the viewpoint of the home gardener has long been the enormous amount of garden space they require. Recently vegetable breeders have solved this problem by altering the vining growth habit of the original cucurbits. The first bush-type cucurbits came in the form of summer squash such as zucchinis and pattypans. Even cucumbers, melons and pumpkins with compact, bush-like growth habits can be obtained easily now from most seed companies.

The confined urban gardener no longer must forego the pleasures of garden fresh cucumbers or melons. Even the apartment gardener can benefit from these compact vegetable plants, which can be grown in containers on balconies or rooftops as long as they receive adequate sunlight.

David Savory, who was a staff member of DBG, designed and selected the material for the vegetable demonstration garden, is now studying agronomy at Colorado State University in Ft. Collins.

Bush varieties claim about ½ to ⅓ the amount of garden space that their vining relatives do, sometimes as little as 3 square feet per plant, as is the case with bush cucumbers. Although fruits of bush cucurbits are usually smaller than those of traditional varieties, the total weight of fruit produced per square foot of garden space is the same or greater.

Almost sounds too good to be true, doesn't it? That's exactly the way I felt when I began hearing about these compact cucurbits. As a result, this past summer I decided to try growing a good cross section of these varieties to see for myself. The raised bed on the south side of the Demonstration Vegetable Garden at Denver Botanic Gardens seemed to be a perfect spot for such a trial. Since this particular bed is only 6½ feet wide any pseudo-bush varieties would quickly be exposed as they wandered onto the adjacent pathways.

Although we are referring to several different vegetables when we speak of cucurbits, it should be noted that their cultural requirements are all quite similar. All are tropical or semi-tropical plants and extremely frost tender. Thus May 22 was chosen as the planting date. By that time the soil has warmed and there is little chance of frost in the Denver area. Not much would be gained by planting earlier since average temperatures of 65^{0} - 85^{0}F are needed for good growth. To promote even, uninterrupted growth a steady supply of water and a well-drained soil are important. These needs can be provided by planting in groups or "hills". The hills were actually 4 feet by 6 feet rectangular mounds of soil with sloped sides with paths between. The mound was about 8 inches higher than the paths, the idea here being to facilitate drainage with the deep bed of loose soil and to add warmth by exposing more soil to the sun. Smaller hills can be made but they

will dry out faster in our semi-arid climate. A soil rich in rotted manure or compost is also beneficial. The preceding fall large amounts of leaves were spaded into the soil for compost. In the spring a 1-2 inch layer of rotted manure and some bone meal were added to the bed before it was rototilled. After the hills were formed two groups of seeds were planted on each leaving about 3 feet between the groups. Later each group was thinned to two or three plants. In early June, after the soil was sufficiently warmed, each hill was mulched with 4-5 inches of straw. This helped to maintain an even supply of moisture between waterings as well as to suppress weeds. As the plants grew larger they shaded the soil around themselves for an added water-conserving effect.

Some gardeners believe that cucurbits will grow better when planted with nasturtiums which are alleged to repel certain pests such as aphids and squash bugs. As an added experiment, a nasturtium was planted on either side of each hill.

Following are brief summaries of the performance of each variety.

Cucumber-*Cucumis sativus* L.

Bush varieties of cucumber such as 'Spacemaster' can be planted anywhere in the garden and will save the work of devising a trellis or other support system and the space required for the traditional cucumber vines. Of all the vegetables tested, this one required the least amount of space with vines that rarely exceeded 3 feet in length. By late July, I began harvesting dark green 5-7 inch long cucumbers of excellent quality. I found these mini-cucumbers to be just the right size for slicing into salads. From a total of four 'Spacemaster' plants I was picking one or two cucumbers each day. The only drawback was that after the fourth week the harvest began to taper off to one cucumber per week. This can be easily overcome with succession planting. Planting one hill every two weeks throughout the early part of the growing season can insure a steady supply of fresh, crisp cucumbers all summer long.

Melons - *Cucumis melo* L.

Muskmelons grow exceptionally well in our hot, dry summer weather. Although honeydew melons are more difficult to grow here, they are a real treat when grown successfully. When harvested from the garden at peak ripeness both possess a sweetness unrivaled by any supermarket melons.

The varieties chosen for testing were the muskmelon, 'Bushwhopper', and a honeydew, 'Oliver's Pearl Cluster'. Usually melons should be set out in the garden as seedling plants rather than directly seeded to compensate for our short growing season. However, I decided to plant the seed directly into the garden since both varieties were reputed to be early-maturing. The germination rates were only 40% using this method. These varieties turned out to be true dwarfs as the vines grew very slowly and averaged about 3½ feet in length at maturity. Fruit began to appear in early August but it was mid-September before any were ripe. 'Bushwhopper' produced an abundance of 4-5 inch diameter fruits. Although not as tasty as other muskmelons I have grown, they are still well worth the effort. 'Oliver's Pearl Cluster' also produced well with about four fruits per plant. These little gems were also 4-5 inches in diameter and had an exceptionally fine flavor. As an

added bonus both varieties exhibited resistance to powdery mildew which attacked most of the other cucurbits.

Since the melons failed to mature as early as I had hoped, I would recommend sowing the seed indoors at least four weeks before planting time in the garden. This should allow a greater number of fruits to ripen before the arrival of fall frost.

30 **Pumpkin - *Cucurbita pepo* L.**

Few things are more fascinating than to watch a tiny pumpkin seedling turn into a huge plant with rambling vines and eventually bear fruits which expand and turn orange just in time for the fall festivities. The test variety, 'Cinderella', is a bush pumpkin which performs such wonders without the usual rambling vines.

Bush Pumpkin

The seeds were sown in late May and, as with the melons, the germination rate was a bit low. The plants grew rapidly and began to set fruit by mid-July. By August 15 I had harvested a 12-pounder. The pumpkins were a brilliant orange with a uniform globe shape perfect for jack-o'-lanterns. The flesh was a good 2 inches thick and cooked down to a delicious puree for making pies or pudding.

Even after harvesting the first few pumpkins, the plants continued to set fruit. Towards the end of August the leaves began to show symptoms of powdery mildew. The last two pumpkins ripened by October 1 even though the plants were practically defoliated by the disease. The flavor of these late pumpkins was quite inferior to those picked earlier, possibly due to the reduced leaf surface area causing a decrease in the flow of sugar to the fruits. The best way to prevent such mildew is to water the plants without wetting the leaves. This can be accomplished by drip irrigation or careful hand watering. To achieve the latter the hills should be made with a dike around the perimeter. The resulting dish can then be filled with water by placing the hose directly into it. This method will aid in water infiltration as well as disease prevention.

Summer Squash - *Cucurbita pepo* L. var. *melopepo* Alef.

Although they come in an assortment of sizes, shapes and colors, all summer squash are cultivars of the species *Cucurbita pepo* var. *melopepo*. The fruits grow quickly and should be picked while still immature, before the rinds or seeds harden. Though they are descendents of the vining cucurbits, summer squashes have been available as bush varieties for several decades. I chose to test 'Early White Bush', a pattypan, and 'Aristocrat', a hybrid zucchini. Both came up quickly and were growing vigorously long before any of the other cucurbits. 'Early White Bush' produced pale green to white, somewhat flat fruits. Four to six of

these squash were harvested per week, a modest yield for a summer squash. The fruits may grow to 7 inches in diameter but are best when picked at about 4 inches. When sliced raw into salads they seem to have a flavor reminiscent of cucumbers.

Anyone who has ever grown zucchini knows that it is a prolific producer regardless of variety. The challenge lies in how to consume the huge amounts of food these bushes are capable of producing. The flavor of the fruit is best when picked small, about 6 inches long, and there is less of it to deal with. 'Aristocrat' seems to have a flavor equally as good as other zucchini cultivars. Both 'Early White Bush' and 'Aristocrat' exhibited considerable resistance to powdery mildew.

Winter Squash - *Cucurbita spp.*

Winter squash produce hard shelled fruits which can be stored for winter use. Their culture is much the same as summer squash except that the mature fruits are harvested at the end of the season. They belong to several different *Cucurbita* species. The two cultivars that I grew, 'Bush Acorn Table King' and 'Butterbush' belong to *Cucurbita pepo* L. and *Cucurbita moschata* (Duchesne) Poir. respectively.

'Bush Acorn Table King', an All-America winner in the vegetable category in recent years, is a dwarf bush variety of the standard acorn squash. The plants were extremely compact, covering about 4 square feet each. They yielded fruit in two separate flushes, maturing in mid-August and late September. The fruits are smaller than the standard acorn squash, but they have similar flavor and keeping qualities.

'Butterbush' was introduced in 1978 and was the first bush-type butternut squash. These plants were also very compact and produced several 1-2 pound fruits per plant. Although the yield was only ⅔ that of the bush acorn squash, I considered their extremely sweet, nutty flavor to be superior.

These two varieties were very susceptible to powdery mildew and lost their vigor long before frost. However, neither their flavor nor their excellent storage qualities appeared to be affected by premature defoliation.

Watermelon - *Citrullus lanatus* (Thunb.) Matsum. and Nakai.

Watermelons are probably the most popular melon in the United States today. 'Sugar Bush' is a watermelon one can enjoy without crowding garden or refrigerator. Each plant produces two or three slightly oval fruits weighing 6-8 pounds each. The vines reach a maximum length of about 4 feet and are easily kept within bounds.

The main difficulty I found to be germination. Of the first planting, at least 18 seeds, none came up. After replanting with an increased number of seeds I was finally able to get two seeds to germinate. Most likely the soil was not quite warm enough for proper germination of this variety. Better results could be obtained by starting plants indoors where the soil would be warmer and temperatures more constant. A greater yield could be expected with this head start. In spite of the early difficulties, the melons which eventually ripened in late September were of exceptional quality, possessing a bright red flesh as sweet and juicy as any standard watermelon.

Most of the bush varieties mentioned in this article are relatively new. Many additional new and improved varieties may be on the market in the near future. Meanwhile, by using proper cultural techniques and taking a few extra precautions, any gardener can have considerable success with any of the currently available bush varieties. Of those I have tested, all may be directly seeded into the garden except the muskmelon, the honeydew and the watermelon. By starting these three indoors a greater germination rate and a larger, earlier harvest should be achieved. All varieties with the exception of the summer squash should be sown using generous quantities of seed to insure the germination of an adequate number of plants. Sowing seed in a light, well drained soil will also be beneficial. Probably most important is watering technique. Powdery mildew is a problem with countless garden plants under irrigation in the Denver area and usually becomes prevelant from August through October. The disease appears as a powdery white film covering the leaves of the infected plant. Watering plants without wetting the leaves, as outlined in the section on pumpkins, can minimize the damage caused by the fungus.

Planting nasturtiums with the cucurbits seemed to have some beneficial effect. Although I saw no outbreaks of squash bugs, there did seem to be an unusually large population of aphids this past summer. Black aphids, which can be a problem with cucurbits, seem to have preferred the nasturtiums. So, in this fashion, the nasturtiums acted as a "trap crop" and were removed from the garden once they became infested. Before removal they added beauty and attracted bees which also pollinate the cucurbit flowers.

Of all the vegetables tested the melons and cucumbers seem to be the most suited to container growing because they are the most compact varieties. The others could also be grown in this manner but would require a slightly larger pot. A 16-22 inch diameter container filled with a loamy, well-drained soil is all that is needed. It is important that the plants receive at least 6 hours of full sunlight and plenty of moisture. On extremely hot days they may have to be watered twice. A straw or bark mulch will help to reduce watering.

There are few things in life more satisfying than raising your own fresh produce. Even the confirmed flower gardener can use these compact vegetables, as any one of the bush varieties would make a handsome addition to the flower bed if placed properly. Be imaginative and give it a try! Whether you live in a small town or large city, apartment or house, the bush cucurbits can add pleasure and fresh produce to your gardening experience.

References

Gilmore, Grant & Holly. 1973. *Growing Midget Vegetables at Home*. New York: Lancer Books, Inc.

Lovelock, Yann. 1972. *The Vegetable Book—An Unnatural History*. New York: St. Martin's Press.

Whitaker, Thomas W. 1977. "Cucurbit Crops—Cucumbers, Gourds, Melons, Pumpkins, Squash—Have Uniform Needs". *Gardening for Food and Fun; Yearbook of Agriculture 1977*. pp. 187-195. U.S. Government Printing Office. Washington, D.C.

Illustration Sources

Front cover: Drawing by Frances Frakes Hansen
Page 3: Photograph by Harlan Clark
Page 6: Photograph by Tom Magee
Pages 8, 11, 14, 15, 17: Drawings by Panayoti Peter Callas
Page 10: Map courtesy of EDAW inc.
Pages 17, 23: Drawings by Janet Wingate
Page 19: Drawing from Britton, *Flora of Bermuda,* by permission of the New York Botanical Gardens
Page 21: Photograph by Josephine Robertson
Page 25: Drawing by Carolyn Ensle
Pages 28, 30: Photographs by Joseph V. Tomocik

The Green Thumb
Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Do Not Fold

The Green Thumb

Summer 1982

Vol. Thirty-nine
Number Two

The Cover

Rock Garden Group
Frances Frakes Hansen

The Green Thumb

Summer 1982
Vol. Thirty-nine, Number Two

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use of the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2548.

The Green Thumb

Summer 1982

Velma A. Richards
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Rock Gardening Discoveries

Sandra Snyder

Many times I have become interested in a plant because a marvelous story is attached to it. Panayoti Callas, my mentor, the Curator of the Rock Alpine Garden at Denver Botanic Gardens, tells a plant story with such intimacy that it feels as if we are gossiping about 1200 worldly people instead of 1200 plants that don't talk or walk. When plants are introduced and discussed by an enthusiast, the tales attached to them are so delightful that I have been inspired to find out about many plants in a short time.

Helleborus niger L. is not a new plant to cultivation. In medieval times it was thought to be good for epilepsy, melancholy, and a frantic feeling. The medieval housewife had recipes for killing wolves, foxes, and probably their cousin, the coyote, using the dry root of *H. niger*. A popular recipe suggested,

> "Dry the root of the black hellebore thoroughly and not in the sun. With this root powder mix one fifth part glass well ground, and one fourth part lily leaf. Then take honey and fresh fat and mix them with the powder. Make it into a hard stiff paste, rolling it into round balls the size of a hen's egg." (Freeman, 1943)

Even if you think it might be the ground glass that controls the coyote instead of putting all of your trust in the Christmas Rose root, and even if you are not a rancher who has a predator problem, this plant will be worth growing in your garden because it is one of the few plants with flowers that will demand your attention in December.

Helleborus niger, of the buttercup family, was the last plant to complete our year round blooming cycle in the Denver Botanic Gardens Rock Alpine Garden. It has large white flowers, suffused with pink, that are 2-3 inches or more across. It is a thornless, large-leaved evergreen that grows in a clump. The clump gets fuller and larger each season but does not grow taller than two feet. The older the plant is the more wonderful its display of impressive flowers after all of the other "roses" have been tucked in for the winter.

The Christmas Rose

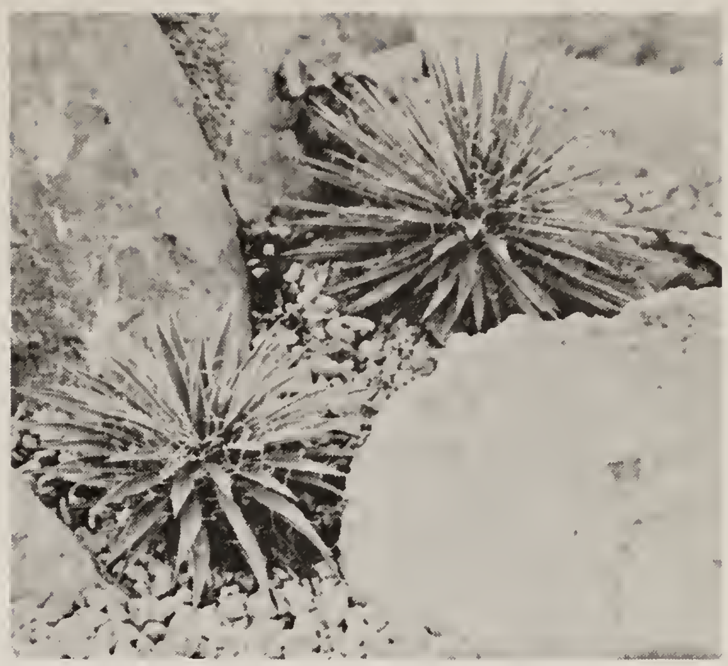
It takes a trained eye to spot many of the marvelous small plants tucked among very large stones. It took a year for me to discover *Hebe buchananii* (Hook. f.) Ckn. & Allan cv. Minor. This tiny plant fascinates

Sandra Snyder is a staff member of the Denver Botanic Gardens working in the Rock Alpine Garden.

me because it is a miniaturists delight. The Rock Alpine Garden has twelve *H. buchananii* cv. Minor plants that grow in clumps about 3 inches around and an inch tall, located in the lower meadow under a small rock ledge. It is supposed to be a very difficult plant to grow. Because I was proud of our twelve, healthy-looking miniature hebes I was inspired to find out more about them. I found no information on this cultivar derived from *H. buchananii,* in the figwort family. *H. buchananii* was named after Mr. J. Buchanan, an early New Zealand botanist. It grows four to eight inches tall with dark, stout, rough branches and dull, sometimes glaucous, thick leaves that vary with its location. In New Zealand its habitat is usually on rock outcrops, fellfields, and other highly exposed sites among cushion vegetation. It is distributed on the drier mountains and lake districts of New Zealand's South Island, at altitudes of 3000-7000 ft.

I have yet to see these plants in bloom with their flower heads near the branch tips crowded with half-inch long blossoms because our three *H. buchananii* plants died last February. But I like the plant's texture so well that I think it is worth trying again and again until we know how to grow this difficult alpine plant in Colorado conditions.

Do you know *Yucca harrimaniae* Trelease? Not many people know about this dwarf yucca. After a lengthy search I found two books that give short descriptions that would hardly inspire anyone to seek out this wonderful yucca that most Coloradans should be proud to know. In *Meet the Natives,* Pesman describes *Y. harrimaniae* as the stubby-leaf soapweed of the western slope with short leaves and pods like



Stubby-leaf Soapweed

large peanuts. In *The Flora of Colorado* Rydberg says *Y. harrimaniae* has linear-lanceolate leaves, short style not swollen and white fleshy fruit. It is found on arid plains and hills of Utah and western Colorado at about 6,500 feet altitude.

I say *Yucca harrimaniae* is a plant that may delight you. Please look at it growing on the southern end of the steppe in the DBG rock garden. When I first saw this miniature yucca I liked it because it looked so cute. Now that I have seen it get plumper, and go through the winter changing its green hues I think it is a marvelous Colorado plant. This diminutive yucca stands approximately 6 inches high and is 6 inches in diameter. In March it has a dusty green color in the middle of its lanceolate leaves with dark yellow-orange on the leaf tips and margins. White threads curling down the sides of each leaf give it a cobweb effect adding to the plant's attractiveness. You, as a Colorado gardener, may enjoy including *Y. harrimaniae* in your garden because it takes up little space, can be grown in local soils, and will do especially well with other drought tolerant plants.

Gaultheria procumbens L. is one of my favorite plants. I knew it as a child and smelling the plant brings back fond memories of walking to the Cape Cod beaches with my grandmother. In the heath family, it has shiny leathery-feeling leaves, elliptical in shape, and up to 2 inches long. Under the leaf is a solitary, nodding, white waxy bell flower that is about ¼ inch long. The fruit is brilliant red and stays on the plant in good condition from August to November. For the rest of the winter the red berry clings to the plant but loses its brilliance as it withers. This berry was the original source of oil of wintergreen which is now obtained from *Betula lenta* L., the eastern river birch.

These evergreen shrubs demand a rather moist, acid soil and some shade. *G. procumbens,* the toughest of the group, will succeed in drier sites than any other of the 30 *Gaultheria* species. H. Lincoln Foster says that carefully dug sods will transplant but need generous amounts of water until re-established. Cuttings are a good method of propagation for *G. procumbens.* The plant can be started from seeds, but will grow very slowly into a sizable plant.

It is a long way from Cape Cod to Colorado, but I am delighted to report that *G. procumbens* is growing in the Rock Alpine garden at DBG. Nestling near a rock to give some shade, it has good drainage in a somewhat acidic soil.

The name *Dianthus* is an abbreviation of the ancient Greek word *diosanthos* meaning the flower of Zeus or Jupiter. Plants bearing this name are to be found in the earliest garden literature. Many of them are great rock garden plants, and it is not difficult to collect enough different *Dianthus* species for your garden to keep them blooming from June through August.

The DBG Rock Alpine Garden has forty different species and varieties of *Dianthus.* The leaves seem to be the same gray dusty color with a lanceolate shape on all of the species, but the growth habit ranges from the tight buns of *D. alpinus* L. to the loose grassy look of *D. cyri* Fisch. & Mey.

Today *Dianthus callizonus* Schott & Kotschy is my favorite. It has a delicate pink flower with a central ring of flecked crimson and white. Its foliage is thin and glaucous, and it attempts to grow in a loose bun. The flower stems are longer and less rigid than *D. alpinus* so it gives the feeling of being a "laid-back," great alpine beauty. Even though Colorado does not provide the humidity that it usually likes, *D. callizonus* is growing beautifully on our scree mound where it gets full sun. The last two winters have proven that this plant is utterly hardy to winter cold.

Rock gardening is a wonderful new discovery for me because I have the feeling it is a subject and a skill that I cannot outgrow. There are many more plants waiting for me to discover.

References

Foster, H. Lincoln. 1968. *Rock Gardening.* Boston: Houghton Mifflin Company.

Freeman, Margaret B. 1943. *Herbs of the Mediaeval Household.* New York: The Metropolitan Museum of Art. p. 35.

Pensman, M. Walter. 1952. *Meet the Natives.* Denver Botanic Gardens, Inc. p. 158.

Rydberg, P. A. 1906. *Flora of Colorado.* Colorado Agriculture Experiment Station Bulletin 100. p. 85.

The Alpine House

Panayoti Peter Callas

Over the last two years, visitors to Denver Botanic Gardens have been puzzled by a structure in the southwest corner of the outside grounds labeled Alpine House. People are accustomed to the notion of greenhouses which grow lush, green, jungle-like plants, but few Americans are aware that it is possible to grow alpine plants away from their lofty homes, let alone in a greenhouse. Alpine houses are a standard feature of European botanic gardens, but most are little more than well ventilated greenhouses. The Alpine House at Denver Botanic Gardens, designed and built by Kelly Oliver, features automatic ventilation and temperature control; it even provides a gentle breeze to discourage mold and fungus and to emulate the breezes of our mountains.

Our public and private gardens are a microcosm of the world. Surviving year after year in local gardens is a variety of South American and South African bulbs and herbaceous plants that one might think too tender for such locations. If even our outside gardens can grow such a variety of plant material, why would one need a greenhouse to grow the hardiest of all plants—those that survive in stressful alpine environments?

Hardiness is a mercurial and relative value. A plant thought of as "bone" hardy can die in a normal Colorado winter. In the alpine house especially rare, unusual or unique plants can be wintered until they can be propagated in sufficient quantity to grow outside.

The conventional alpine house, which evolved in Great Britain and Europe over the last fifty years, is essentially a modified greenhouse designed to provide protection from excessive wetness in maritime climate winters. Most alpine plants are adapted to cool, moist summers and cold, dry winters when the plants are insulated under a blanket of snow, the solid—and therefore dry—state of water. Many of the exotic alpine plants introduced during the early decades of this century by the great Asian plant explorers were lost because they could not tolerate the vicissitudes of lowland winters. The frequent mild, subtropical interludes in western European winters alternating with devastating frosts and drenching rains would cause all but the most tolerant of alpines to rot. Protected outside under a cloche, or in the controlled environment of an alpine house, the same plant would often flourish. The traditional alpine house, then, is a dry place for plant and gardener to repair during the inclement months. During Colorado winters, considerably more alpine than most maritime regions, plants are far more likely to die of dessication than of frost. The Alpine House in Denver Botanic Gardens is therefore different in conception from traditional, maritime-climate alpine houses.

Panayoti Peter Callas is Curator of the Rock Alpine Garden at Denver Botanic Gardens.

The Alpine House at Denver Botanic Gardens is a place where temperate and alpine plants from around the globe can be grown for educational and aesthetic purposes. The plants selected to grow in this house on a rotating basis, such as the tiny alpine Kabschia saxifrages, are those that cannot tolerate the excessive sun of a Colorado winter. *Brachychome* species from Australia and *Celmisia* and *Raoulia* species from New Zealand are examples of true alpines in their native haunts but are not hardy here because Colorado is too cold. It is, therefore, a structure designed to mitigate the extremes of our steppe climate. It must protect plants from the coldest temperatures of winter and from the hottest temperatures of summer.

In addition to highlighting special plants, the Alpine House is a convenient place to stage exhibitions and comparative displays of plant and ecological groupings. The entire collection of plants displayed in the house is buried to the pot rims in a bed of river sand. Many groundcovers are being encouraged to form mats so that various blooming, specimen plants can be plunged in their midst. The sand has proven to be an excellent medium—helping to keep the pots from drying out too quickly and at the same time lending a clean appearance to the soil surface. Rocks placed strategically in the planting beds lend a naturalistic aura and provide footing for workers trying to replace plants in more remote corners of the bed.

The back room of the Alpine House contains table space, files and drawers for information relating to the plant collections in the Rock Alpine Garden and Alpine House. It also contains storage space for tools and labels. The principal purpose of the back room in future years will be to propagate and study the growth of more difficult alpine plants under carefully controlled conditions. Provisions have been made so that refrigerated cases can be installed to simulate tundra temperatures.

A very useful aspect of the building, not initially included in the plans, is a display case along the north wall of the exhibition room. Featured here will be a number of educational displays being prepared under the direction of Evelyn Murrow, a talented and dedicated volunteer in the Rock Alpine Garden. The purpose of these displays is to elucidate plants within the garden and the house itself, explaining their natural and ecological associations. The first display in March and April of 1982 featured the gentian paintings of Carolyn Crawford. These paintings, done in the summer and fall of 1981, were executed either in the Rock Alpine Garden or in the wild. They may be shown perennially during the height of gentian season in the garden. A display on wild iris in nature and in the garden was presented in conjunction with the national convention of the American Iris Society in June, 1982. During the mid-summer months and coinciding with the annual meeting of the American Rock Garden Society in Boulder, July 2-4, 1982, herbarium specimens of some Colorado alpine plants are on exhibit.

Although plants have been growing in the Alpine House for less than a year, it appears that this will be an excellent place in which to grow a broad variety of temperate and alpine plants. Certain groups of plants will be featured seasonally.

The Alpine House at Denver Botanic Gardens

Winter

In winter the Alpine House will be far from dormant. Although temperatures will be allowed to approach freezing most cold nights, the plants in the house will not be allowed to freeze. The alpine saxifrages, particularly those in the Engleria and Kabschia sections, will tolerate this relative warmth; beginning in February one can admire the large collection of these alpine saxifrages amassed here. Ferns and other foliage plants such as *Hebe* species and bright green mats of prostrate *Mimulus* and *Fuchsia* help enliven the Alpine House during these quiet days. Towards the end of winter, there is an increase in activity. The brilliant purple, feathered *Crocus imperati* Tenore and the miniscule trumpet *Narcissus asturiensis* (Jordon) Pugsley usher in the season of bulbs.

Spring

Spring in the Alpine House is the season of bulbs in bloom beginning with a plethora of unusual crocuses obtained from European collectors. These and other bulbs will be brought in from plunge beds where they are allowed to stratify, and whence they return once their flowers fade. Crocuses are quickly followed by dwarf species of narcissus such as the vigorous and beautiful hybrid of *Narcissus triandus* L. 'April Tears.'

Tulips grow well in the house and their blossoms endure for many days in the cool air. *Tulipa schrenkii* Regel from central Asia is the first to bloom, with its tiny flowers produced almost on the ground. Only a few species of tulips occur near alpine altitudes in central Asia, but they are characteristic of the dry, rocky environments we associate with the most dramatic of rock garden bulbs, the fritillaries. Denver Botanic Gardens has begun to assemble a collection of these exotic bulbs, with their tesellated blossoms and unusual colors. These plants are capricious when planted directly into the garden, but almost all fritillaries are manageable in frames and in the alpine house.

As the bulb season draws to a close, the alpine house bursts into a mass of color from the principal groups of spring alpine plants: primulas, androsaces and saxifrages. Rock garden shrubs such as teucriums, verbascums and origanums have proven to be excellent ways of relieving the monotony of tiny, rosetted plants in the house. These mostly bloom in the late spring months.

Summer

Summer in the Alpine House means campanulas. This massive genus is the backbone of the rock garden in the hot months. The cool lavender flowers in a constant kaleidescopic variety of sizes, shapes and textures can be especially appreciated close up in the alpine house. Summer is also the season for most *Dianthus* species. Their bright pinks form a fine contrast to the cool bellflowers. There are many species of *Dianthus* in the garden, and these will be exhibited in June and July in the house.

Autumn

Autumn is the quietest time in the Alpine House. At this time of year, there is a relative paucity of plant material blooming in the garden as well, compared with the earlier periods in the year. As if to make up for a lack of variety, gentians blossom with an almost vindictive intensity of color. Many gentians will be featured in the Alpine House during the late summer and well into autumn, where they can be examined in detail. The most outstanding autumn gentians are those belonging to the section *Frigida* from western China, Tibet and the Himalayas. *Gentiana veitchiorum* Hemsl., *G. farreri* Balf.f., *G. sino ornata* Balf.f., *G. ornata* Wall., *G. hexaphylla* Maxim. Their relatives and progeny are dazzling in a mass and interesting viewed individually.

The Alpine House is to be visited not just once but often, for it has something special to offer at all seasons.

Scott Wilmore 1896–1982

Scott Wilmore, well-known Colorado nurseryman, was a friend of Denver Botanic Gardens since its founding. When Colorado Forestry and Horticulture Association was formed in 1943 with a primary goal, to establish a great botanic garden on the High Plains, Scott was among its first members. In fact, he was its president when the two organizations merged in November 1960.

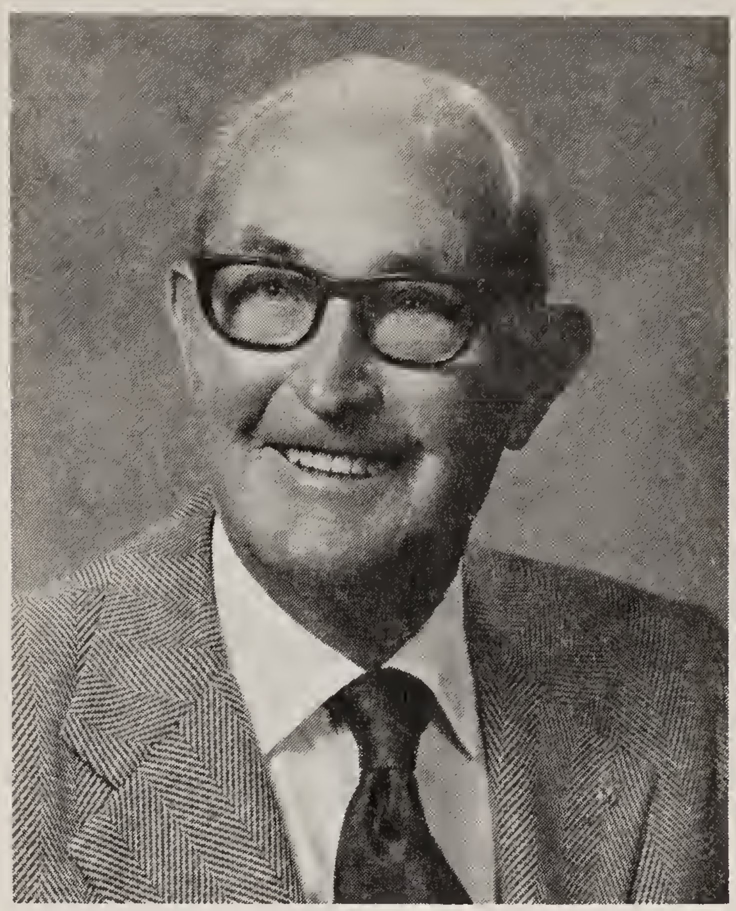
Scott's father was W. W. Wilmore, horticultural pioneer who, in 1886, started a cut-flower business near what is now West 38th Avenue and Wadsworth Boulevard where he gained national prominence as a specialist in growing and hybridizing dahlias. Shortly after World War I Scott and his brother, Charles, persuaded their father to expand his business into a full-scale nursery. For several years the

nursery was a family partnership. Eventually Scott and his wife, Ruth, acquired ownership and Charles started Green Bowers Nursery in east Denver. Although W. W. Wilmore Nurseries, Inc. was sold to Mr. and Mrs. Steve Driftmier in 1972 Scott retained his favorite desk at the office and served as "checkup man" for customers.

Always cooperative and full of good humor Scott generously shared his time, his horticultural expertise and hundreds of plants from the nursery for Plant Auctions, the first garden fairs and garden shows and donated early plantings at Denver Botanic Gardens. A charter member of the Denver Rose Society, he provided trophies for the first rose shows. He was named Nurseryman of the Year by the Colorado Nurserymen's Association some time ago and more recently was in the honor spotlight at a Colorado Garden and Home Show.

Many years ago, to the chagrin of local horticulturists and officers of C.F. & H.A., an eastern mail-order nursery dispatched a crew of door-to-door salespeople into this area. Few of them understood plant hardiness in our mile-high climate. Scott conquered the problem by hiring and retraining a number of the salesforce. Always innovative Wilmore's was one of the early nurseries to sell container-grown stock. Perceptive regarding the future of Denver Botanic Gardens, Scott viewed the Annual Plant Sale as an important public relations as well as profitable event and willingly supported the transition from Auction to Sale.

Although both broadleafed and needled evergreens were among his many horticultural interests, Gray



Gleam juniper was his greatest joy. In February 1945 while scouting for new or outstanding junipers in Mount Vernon Canyon he spotted a spectacular silver specimen on the lower side of a huge boulder. As he related the discovery, the juniper was about six feet in height and about the same in spread. He was so excited about the find that he whistled and called several times to his scouting companion, Bob More, who must have been about a quarter-mile or so up the mountain. (Bob had an arboretum at his summer home near Buffalo and later gave the Pinetum at Denver Botanic Gardens when it was located in City Park.) When Bob came within talking distance he asked if Scot had found something. "Come see for yourself," was the reply. Bob was spellbound. They took about 50 scions from the tree and Scott later distributed it. Thus Plant Patent 848, Gray Gleam Juniper, was born—one of Scott Wilmore's many legacies toward beautifying Colorado's home and public landscapes.

BEP

Meet The Genus *Penstemon*

Susan Praetz

Wildflowers that grace our land, from the mountains to the seas, include some of the most beautiful and interesting groups of plants known to man. Among them is the genus *Penstemon* with about 235 species. Penstemons are endemic to North America—only one species has been found in another area. Perhaps as the American eagle represents our freedom, the penstemon should officially represent our beauty. They are found in almost every state and in many situations. They grow in alpine meadows, out of rock walls, on the prairie, in canyons, on mountain peaks, and most successfully under cultivation in the gardens of towns and cities.

Penstemons belong to the figwort family, Scrophulariaceae, which includes snapdragons and Indian paintbrush. As a group penstemons might be described as perennial herbs or small shrubs with leaves opposite or whorled, lower ones petioled, upper sessile, and entire or serrate. The flowers are mostly bell-shaped with their five lobes divided into two lips, one above, one below, borne in terminal racemes or panicles. As the name, derived from the Greek *pente* (five) and *stemon* (stamen), indicates, penstemons have five stamens, one of which is sterile and often hairy. These plants are among the most varied in physical characteristics. They may be herbaceous, woody, evergreen, deciduous, and one might be considered a vine. Flower colors range from white to bright reds, purples and blues. Leaf color, texture and size vary greatly and pleasingly. The plants range from just a few inches in height to well over 5 feet.

In rock gardens the penstemons are among the most beautiful plants and provide the gardener with tools to drape, cover, accent, surround or maintain his creation. Penstemons bloom mostly in May or June, but often offer colorful foliage and texture through the year. Rock gardens afford stimulation throughout the year; penstemons are special for the same reason.

In choosing a penstemon it is important to know the plant's native environment, unless, of course, it is a hybrid. Once this is known one can assume that, if he can grow one representative of a group, he can probably grow others of the same group successfully. While penstemons are divided into groups primarily on the basis of floral structure and growth habit, these groups, in general, fit within geographic boundaries which give much information about the types of plants and their cultural needs.

Susan Praetz, Botanist-Florist at Denver Botanic Gardens, is a member of the American Penstemon Society and the American Rock Garden Society.

Following is a brief summary of some of the major groups using the taxonomic categories and sequence of arrangement employed in The American Penstemon Society's *Manual for Beginners,* 3rd edition revised, 1981, originally prepared by Ralph W. Bennet and revised after his death by members of the American Penstemon Society. Facts concerning the penstemons discussed are from the references cited, as well as from personal experience with cultivating some of the species.

Subgenus *Penstemon*

Commonly referred to as the eastern group because geographical perimeters include the eastern United States, its most popular members include *P. digitalis* Nutt. *ex* Sims, *P. hirsutus* (L.) Willd. and *P. smallii* Heller. Although easily grown in most parts of the country, knowing this group's native habitat with its springs and acid soil provides the key to satisfactory culture. Plants from this group can tolerate shade but also enjoy open sunlight and are easy to grow from seed. As with all penstemons, for good performance they require good drainage and ample space. *P. hirsutus* is most adaptable to rock gardens, forming a mound from 5-15 inches across. Improved selections provide pink and purple flowers on stems only 6-8 inches high.

Section *Elmigera*

Elmigera species are at home in the Southwest and in the Rocky Mountains where they live in dry areas and include the beautiful red-flowered species. *P. barbatus* (Cav.) Roth, although tall for the rock garden, is suitable for a boundary. It is brilliant in the wild with stems 3-4 feet high. The source of much hybridization, its improved varieties are available from commercial sources.

Section *Habroanthus*

Habroanthos means beautiful flowers, and its blue and purple flowers are truly spectacular. This group inhabits the plains and spreads to the foothills. They like dry, alkaline soil and much daily sunshine. Among the 34 species in this group many accent rock gardens. Included are *P. unilateralis* Rydb., *P. alpinus* Torr., *P. glaber* Pursh, and *P. strictus* Benth. Rocky Mountain penstemon, *P. strictus,* is drought resistant and can serve many purposes. Winter provides a basal rosette and summer, magnificent bluish-purple flowers high on a stalk.

Penstemon alpinus

Section *Anularis*

This group is physically structured to endure hot, dry conditions. Leaves are thick and succulent and hold water for survival. In fact, overwatering can be devastating. They live on the plains and prairies. Good drainage is the important factor, and many grow best in gravel. Included here are *P. grandiflorus* Nutt., *P. nitidus* Dougl., and *P. angustifolius* Nutt. A blue-flowered native of the Denver area,

P. angustifolius can be pink under cultivation. It is low-growing and good for a rock garden.

Subgenus *Dasanthera*

The shrubby penstemons are an amazing group of plants. Woody with evergreen leaves, they flower in spring and portray many different colors. They can be low, densely mat-forming or loose and sprawling, some over 18 inches tall. Members of this group, a favorite of rock gardeners because of the massing and beautiful flowers and foliage, include *P. cardwellii* Howell, *P. fruticosus* (Pursh) Greene, *P. rupicola* (Piper) Howell, and *P. davidsonii* Greene. *P. cardwellii* is spectacular with purple flowers above low, spreading foliage.

Section *Ericopsis*

These mat-forming, somewhat shrubby plants grow in the Southwest and in Colorado. They prefer dry, sunny conditions but are somewhat difficult to grow. Representatives are *P. crandallii* A. Nels. and *P. linarioides* Gray.

Subgenus *Saccanthera*

This large group grows from Idaho westward. They have beautiful flower stalks rising majestically from the base. *P. serrulatus* Menz. and *P. richardsonii* Dougl. are in this group and can be adapted to the garden. *P. richardsonii* may be either pink, blue, or purple.

Section *Aurator*

This widespread section may be difficult to cultivate. Although short-lived, *P. cobaea* Nutt. has huge violet-purple flowers and is the most successful candidate in our area.

Subsection *Humiles*

These native Rocky Mountain plants range in height from low to medium and tolerate partial shade. *P. ovatus* Dougl., tall with blue flowers, is the best to try.

Subsection *Proceri*

This interesting group of western species are low-growing clump formers and have flowers in many colors borne close to the clump. Examples are *P. procerus* Dougl., *P. rydbergii* A. Nels., *P. confertus* Dougl. and *P. peckii* Penn.

Subsection *Peltanthera*

The desert regions of Arizona and New Mexico are best for growing this group. *P. spectabiles* Thurb. *ex* Gray is a good representative.

Penstemon angustifolius

Subsection *Centranthifolii*

Native to California and not widely grown elsewhere, *P. centranthifolius* Benth. is one of this group.

Subgenus *Hesperothamnus*

Again, these woody shrubs grow in California and are not easily adaptable for gardens in Colorado.

Hybrids

For the beginner penstemon hybrids grow readily and provide instant beauty. Many are available commercially and through the American Penstemon Society Seed Exchange. Glenn Viehmeyer at the University of Nebraska Agricultural Research Station did much to provide us with the hybrids of today, and certainly much more can be done to breed desirable plants. Penstemon hybridization is virtually an untapped area.

Success with penstemons requires some research and some trial and error. Copying the native environment is helpful, and choosing proper plants for proper places will also be a plus. When they perform, they are unsurpassed in beauty and versatility. The American Penstemon Society represents the current authority on penstemons. It is an enthusiastic group of people who provide literature, seed exchange and encouragement.

The Denver Botanic Gardens maintains many examples of adaptable penstemons both in the Rock Alpine Garden and elsewhere, with new ones being tried each year. Every rock garden should have at least one penstemon, and chances are if you have one you'll want more—it becomes an insatiable journey.

Penstemon unilateralis

References

American Penstemon Society. 1981. *Manual for Beginners, 3rd edition (revised).* APS Pamphlet.

Bennett, Ralph W. 1960. *Penstemon Nomenclature, Supplement to Bulletin XIX.* American Penstemon Society.

Viehmeyer, Glenn. 1961. *Penstemon in Your Garden.* University of Nebraska College of Agriculture.

A Guide to the Common Wildflower Families of Colorado

Janet L. Wingate

The study of wildflowers is a popular and rewarding hobby. "Which plant is that?" is often asked or wondered about. One aid in the identification of wildflowers is the ability to place them into their proper plant family. This knowledge provides a "head start" in the identification of the wildflower.

Thirty common wildflower families found in Colorado were selected and divided into 7 groups according to basic floral structure. A few key characteristics are given for each family within the group. Most families can be recognized by these few characteristics once the basic floral structure is known. Representative genera with common names are listed for each family. Some families are included in more than one of the groups because of their varying characteristics.

To use this guide one must know the parts of the flower (fig. 1) and some general characteristics of the floral structure. The ovary is superior when the stamens, petals,

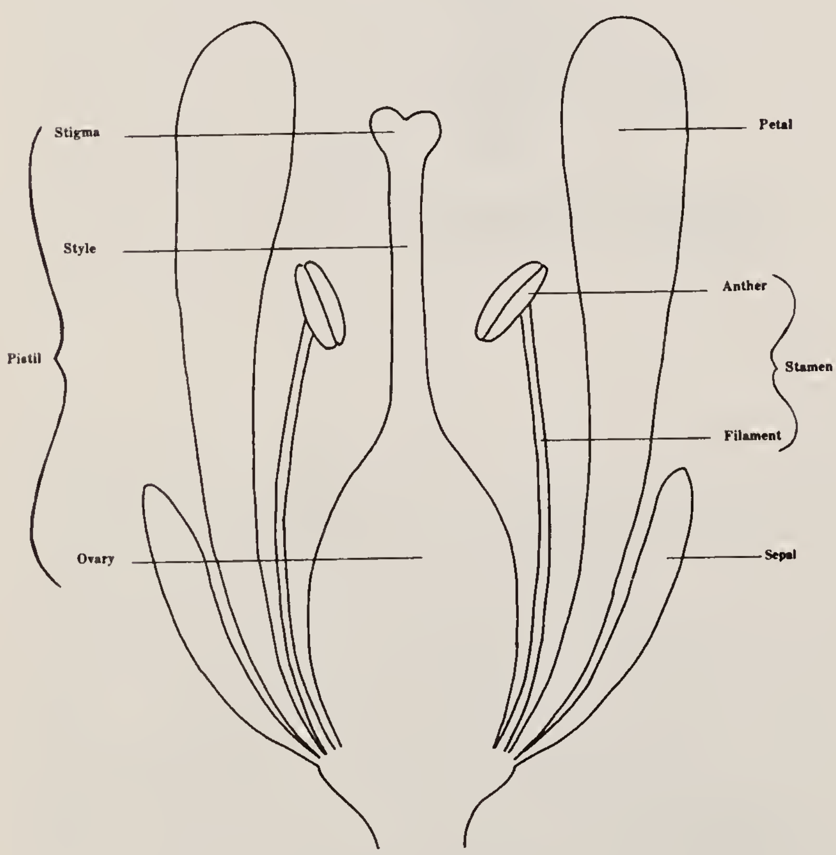


Fig. 1 Flower Parts

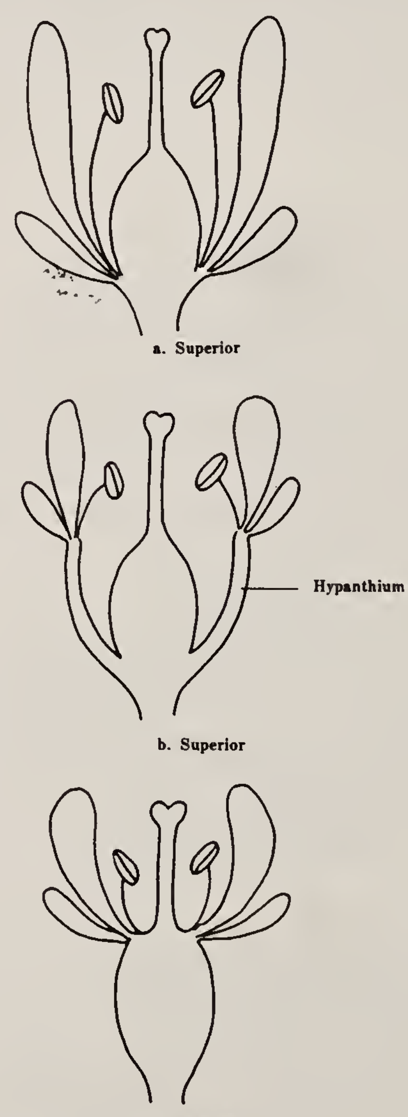


Fig. 2 Ovary Position

Janet L. Wingate, Ph.D., a staff member of Denver Botanic Gardens, works in the Kathryn Kalmbach Herbarium.

and sepals are attached at the base of the ovary (fig. 2a) or when they are attached to a hypanthium which is not fused to the ovary (fig. 2b). If the stamens, petals, and sepals are attached to the top of the ovary, the ovary is inferior (fig. 2c). Flowers are regular or irregular. A regular flower is radially symmetrical (Harebell) while an irregular flower is bilaterally symmetrical (Penstemon). These and other terms used in this article can be found in the glossary of any flora or botany text.

Unless otherwise stated the following plant families are usually herbaceous with 5 sepals, 5 petals, 5 or 10 stamens, and 1 pistil.

PETALS SEPARATE, OVARY SUPERIOR, FLOWER REGULAR

BERBERIDACEAE (Barberry Family) Flower parts in multiples of 3; stamens 6 and opposite the petals; flowers yellow; plants woody with holly-like leaves. *Mahonia* (Grape Holly)

CAPPARIDACEAE (Caper Family) Sepals 4; petals 4; stamens 6 to many and extending beyond the petals; leaves palmately compound. *Cleome* (Rocky Mountain Bee Plant)

CARYOPHYLLACEAE (Pink Family) Nodes swollen; leaves opposite; stamens usually 10; ovary 1-celled. *Cerastium* (Mouse Ear)

COMMELINACEAE (Spiderwort Family) Sepals 3 and green; petals 3 and often blue; veins of leaves parallel; stamens 6 with hairy filaments; leaf bases sheathing. *Tradescantia* (Spiderwort)

CRASSULACEAE (Stonecrop Family) Pistils 4 to 5 and separate or united at base; plants succulent. *Sedum* (Stonecrop)

CRUCIFERAE (Mustard Family) Sepals 4; petals 4; stamens 6 (2 short, 4 long); fruit with partition in middle which remains after the seeds fall; inflorescence a raceme. *Erysimum* (Wallflower)

ERICACEAE (Heath Family) Plants often with a somewhat scapose habit; stamens 10; anthers opening by terminal pores; fruit a many-seeded capsule. *Pyrola* (Wintergreen)

GERANIACEAE (Geranium Family) Fruit long beaked and splits up from base at maturity; leaves palmately lobed or pinnately compound. *Geranium*

LILIACEAE (Lily Family) Sepals 3 and resemble petals; petals 3; stamens 6; veins of leaves parallel. *Calochortus* (Mariposa or Sego Lily)

MALVACEAE (Mallow Family) Stamens numerous with fused filaments; hairs starlike (stellate). *Sphaeralcea* (Cowboys Delight)

PAPAVERACEAE (Poppy Family) Petals 4 to 6 and crumpled in bud; sepals 2 to 3 and falling as flower opens; stamens numerous; flowers showy. *Argemone* (Prickly Poppy)

POLYGONACEAE (Buckwheat Family) Flower parts often in multiples of 3; stipules sheathing when present; nodes often swollen; plants sometimes woody at base. *Eriogonum* (Sulfur Flower)

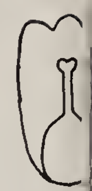
PORTULACACEAE (Purslane Family) Sepals usually 2; stamens opposite petals; plants succulent. *Claytonia* (Spring Beauty)

RANUNCULACEAE (Buttercup Family) Stamens numerous; pistils 3 to numerous (rarely 1); plants usually herbaceous but may be climbing and woody. *Ranunculus* (Buttercup)

ROSACEAE (Rose Family) Herbaceous or woody plants with numerous stamens (sometimes 5); hypanthium; pistils 1 to many. *Potentilla* (Cinquefoil)

SAXIFRAGACEAE (Saxifrage Family) Pistil often 2-horned; hypanthium; leaves often basal. *Saxifraga* (Saxifrage)

PETALS SEPARATE, OVARY SUPERIOR, FLOWER IRREGULAR



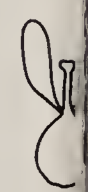
RANUNCULACEAE (Buttercup Family) Stamens numerous; pistils 3 to 5 (rarely 1). *Delphinium* (Larkspur), *Aconitum* (Monkshood)

FUMARIACEAE (Fumitory Family) Sepals 2 and tiny; petals 4 with one outer petal spurred; 2 inner petals united at top; stamens 6 and united in threes; leaves compound. *Corydalis* (Golden Smoke)

LEGUMINOSAE (Pea Family) "Pea" type flower (keel, 2 wings, and a banner); leaves compound; fruit a legume (bean-like); mostly herbaceous plants. *Thermopsis* (Golden Banner)

VIOLACEAE (Violet Family) "Violet" type flower; 1 petal spurred; 1 flower per flower stalk; ovary 3-celled. *Viola* (Violet)

PETALS SEPARATE, OVARY INFERIOR, FLOWER REGULAR



CACTACEAE (Cactus Family) Succulent plants with spines; flowers showy with numerous stamens. *Opuntia* (Prickly Pear)

IRIDACEAE (Iris Family) "Iris" type flower; leaves folded in half lengthwise; sepals 3 and resemble petals; styles 3 and resemble petals; petals 3, stamens 3. *Iris*

ROSACEAE (Rose Family) Trees or shrubs with numerous stamens (sometimes 5); fruit apple-like (pome). *Crataegus* (Hawthorn)

GROSSULARIACEAE (Gooseberry Family) Shrubs; hypanthium (short or long); leaves lobed; sepals resemble petals; fruit a berry. *Ribes* (Gooseberry, Currant)

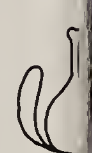
LOASACEAE (Loasa Family) Leaves with hooked hairs (leaf will stick to clothing); stamens numerous. *Mentzelia* (Evening-star)

ONAGRACEAE (Evening-primrose Family) Sepals 4; petals 4; stamens 8. *Oenothera* (Evening Primrose)

SAXIFRAGACEAE (Saxifrage Family) Ovary usually partially inferior; pistil often 2-horned; leaves often basal. *Saxifraga* (Saxifrage)

UMBELLIFERAE (Parsley Family) Inflorescence an umbel; flowers small; stems commonly hollow; leaves usually compound; leaf bases sheathing. *Lomatium* (Salt-and-pepper)

PETALS FUSED, OVARY SUPERIOR, FLOWER REGULAR



ASCLEPIADACEAE (Milkweed Family) Flowers with hooded appendages between petals and stamens; ovaries 2, style and stigma 1; sap milky; leaves opposite or whorled. *Asclepias* (Milkweed)

BORAGINACEAE (Borage Family) Ovary 4-lobed and developing into 4 nutlets; folds or appendages common in the throat of corolla; plants often with stiff, bristle-like hairs (hispid) and often with a coiled inflorescence. *Cryptantha, Mertensia* (Chiming Bells)

ERICACEAE (Heath Family) Usually low woody plants with evergreen leaves, anthers opening by terminal pores or longitudinal slits, flowers often urn-shaped. *Arctostaphylos* (Kinnikinnik)

GENTIANACEAE (Gentian Family) Sessile leaves which are opposite or whorled; leaves and stems not hairy (glabrous); ovary 1-celled, stigma usually 2-lobed. *Gentiana* (Gentian)
HYDROPHYLLACEAE (Waterleaf Family) Stamens protruding beyond petals; inflorescence often coiled. *Hydrophyllum* (Waterleaf), *Phacelia* (Purple Fringe)
POLEMONIACEAE (Phlox Family) Stigma 3-branched; ovary 3-celled; plants may be woody at base. *Phlox, Ipomopsis* (Trumpet Gilia)
PRIMULACEAE (Primrose Family) Stamens opposite petals. *Primula* (Primrose), *Dodecatheon* (Shooting Star)

PETALS FUSED, OVARY SUPERIOR, FLOWER IRREGULAR

LABIATAE (Mint Family) Ovary 4-lobed and developing into 4 nutlets; stems square; leaves simple and opposite; stamens 4. *Mentha* (Mint)
SCROPHULARIACEAE (Figwort Family) Stamens usually 4, often a sterile 5th stamen is present; ovary 2-celled and developing into a capsule; leaves commonly opposite. *Penstemon*

PETALS FUSED, OVARY INFERIOR, FLOWER REGULAR

CAMPANULACEAE (Bellflower Family) Bell-shaped flower; fruit a many seeded capsule. *Campanula* (Harebell)
CAPRIFOLIACEAE (Honeysuckle Family) Shrubs with opposite leaves. *Lonicera* (Honeysuckle)
COMPOSITAE (Sunflower Family) Flowers grouped tightly together and surrounded by bracts (inflorescence a head); plants herbaceous or woody. *Aster*
ERICACEAE (Heath Family) Low woody plants; anthers opening by terminal pores; fruit a berry. *Vaccinium* (Blueberry, Huckleberry)
RUBIACEAE (Madder Family) Sepals 4; petals 4; leaves opposite or appearing whorled due to large leaf-like stipules; stems square. *Galium* (Bedstraw)
VALERIANACEAE (Valerian Family) Stamens 3; leaves opposite. *Valeriana* (Valerian)

PETALS FUSED, OVARY INFERIOR, FLOWER IRREGULAR

CAMPANULACEAE (Bellflower Family) Inflorescence a raceme; fruit a many seeded capsule. *Lobelia*
COMPOSITAE (Sunflower Family) Flowers grouped tightly together and surrounded by bracts (inflorescence a head); plants herbaceous or woody. *Agoseris* (False Dandelion)
VALERIANACEAE (Valerian Family) Stamens 3; leaves opposite. *Valeriana* (Valerian)

Useful References

Harrington, H. D. 1954. *Manual of the Plants of Colorado.* Chicago: Swallow Press, Inc.

_______________ 1957. *How to Identify Plants.* Denver: Sage Books.

Nelson, Ruth Ashton. 1979. *Handbook of Rocky Mountain Plants.* Estes Park, CO: Skyland Publishers.

Porter, C. L. 1967. *Taxonomy of Flowering Plants.* San Francisco: W. H. Freeman and Company.

Focus On ALOES in the Boettcher Memorial Conservatory

Peg Hayward

Aloes are dramatic and decorative succulent plants of the lily family, Liliaceae. There are about 200 species of aloe, more than half of which come from South Africa. They should not be confused with the agaves of America which are similar in foliage but not in their flowers. *Aloe* is a varied genus ranging from dwarf clumps with clusters of leaves arising from the base to others which become treelike with stout woody stems.

The appeal of aloes is in the beauty of their foliage. Pointed, thick, succulent leaves, usually with serrated edges, fan out in a rosette, or sometimes in spiral form or in ranks from the base or stem. The leaves store large quantities of water during rainy periods so they can withstand long periods of drought.

Several aloes are represented in the Boettcher Memorial Conservatory collection. *Aloe barbadensis* Mill. (known as *A. vera* L. for nearly 200 years) is native to the eastern Mediterranean region. This aloe has been cultivated in Egypt since remote times, especially as a cemetery plant and sometimes as boundary marks between fields.

Peg Hayward writes "Focus On" as a regular feature of *The Green Thumb.*

Because of its great antiquity it has inspired its share of superstitions and fables. One story relates that the ancient Egyptians knew the aloe as the "plant of immortality" and that drawings of it appear painted on vases and on the walls of tombs.

A. barbadensis stands 18 to 36 inches tall and has approximately 15 thick lance-shaped leaves forming a rosette at the base. New leaves form in the center of the stemless rosette. The upper surface of the leaves is flat, the lower convex; edges are serrated with firm pale teeth at half-inch intervals. The leaves are from 1 to 3 inches wide at the base and taper to a sharp point. Average weight of mature leaves is one pound but may be much more. Without stem or woody parts, the leaves are held upright by the water pressure of the gel. The flower stalk springs from the center of the rosette to a height of 4 feet with yellow tubular flowers.

A. barbadensis is popularly known as medicine plant or burn plant. Its curative powers have long been used for tonics, burns, insect bites and other pain relievers. Accounts have stated that the leaf is of use in the treatment of X-ray burns. Today it is grown commercially for beauty preparations and suntan lotions. The yellow latex in the green skin

of the leaves when dried is the laxative "bitter aloes" of the drug trade.

A. bainesii Dyer of South Africa is one of the largest of the genus. It attains a height of 60 feet. The trunk when about 6 feet high branches dichotomously (in pairs). Fleshy sword-shaped leaves are clustered at the ends of the branches. Salmon-pink flowers tipped with green occur in dense, many-flowered racemes.

A. arborescens Mill., tree or candelabra aloe, is another South African species. Branching from the base and rebranching higher up this aloe forms a dense shrub-like bush with many rosettes, usually inclined at an oblique angle. The narrow, curved, sickle-shaped leaves are bluish-green, edged with yellow horny teeth. Conical, coral-red to scarlet racemes are simple, with up to 4 from a rosette. There are also yellow-orange and yellow-green forms. This aloe varies considerably according to locality.

Some African species of aloe have fibers in their leaves used for cordage, fishing nets and coarse cloth. Others have a finer fiber which can be made into lace. Still others are the source of a violet dye.

Many aloes have interesting variegated leaves. These as well as most of the aloes make picturesque house plants.

References

Bailey, L. H. 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

Jeppe, Barbara. 1969. *South African Aloes.* Cape Town, South Africa: Purnell.

Reynolds, G. W. 1966. *The Aloes of Tropical Africa and Madagascar.* Cape Town, South Africa: Cape and Transvaal Printers Limited.

Aloe barbadensis

A Garden of Many Facets

Charles (Randy) Randolph

The Home Demonstration Garden is a multi-faceted landscaped gem set at the southern edge of Denver Botanic Gardens. Sponsored by the Garden Club of Denver it reflects many innovative ideas and enthusiasms shared by the club's members.

Bea Taplin (Mrs. T.E.) was responsible for the selection and direction of Lifescape Ltd. as designers of the Home Demonstration Garden and ultimately worked quite closely with Lifescape during the construction phase of the project. The Home Demonstration Garden was of particular interest to me as a design project. It incorporated all the detail of a residential project yet still had to function as an integral part of Denver Botanic Gardens' master plan.

Mrs. Taplin provided the initial design input. This consisted of approximately 26 individual design concepts submitted by members of the Garden Club of Denver. This created not only an extremely interesting design project but an amazingly challenging one. Design by committee can present problems; however, in this case it could not have been a more pleasant experience. Each member's sketch plan was reviewed carefully. Design concepts and details were extracted and integrated into the design master plan. The fact that the project was a home demonstration only increased the variety of input and solutions. As we sorted through the various design criteria, we began to identify common inputs, important focal points and a multitude of construction details. These evolved into a list of items to be included in the project. The list consisted of a terraced vegetable garden, aspen grove, water feature, lath house, compost area, rose garden, perennial gardens, informal portions of the garden, formal garden areas, shade structure, handicapped access to the entire garden, stairways, various paving materials, use of water conservation, mulches, elimination of sod, annual beds, retaining walls, overlook view sheds and berming. All of these items were to fit into a 75 feet by 95 feet space.

Along with the list of items to be included was the desire to produce a unique individualistic garden, yet blend smoothly into the overall scheme of Denver Botanic Gardens.

Charles (Randy) Randolph, a graduate of the University of Wisconsin at Madison, formed Lifescape Ltd., a landscape design and construction firm doing both small residential and large scale commercial projects in landscaping.

Lath House in the Home Demonstration Garden

The long list was a function of the incredible variety of construction techniques utilized in the Colorado home landscape. The use of the vegetable garden, water feature and shade structures are of particular value in the Colorado residential landscape and tend to function as focal points of this demonstration garden. The terraced vegetable garden takes up grade, acts as a retaining wall for the stairs and provides wonderful vegetables during the summer. The small pond and brook attract small birds and provide a cooling sound throughout the garden. The shade structure reflects the diamond pattern and roof line of the Conservatory and functions practically as a shelter for informal garden seminars. Similar structures used on a smaller scale can add both a focal point or gathering area for relief from the intense Colorado summer sun. Potted plants and vines also thrive under the filtered shade and can add additional interest to the home landscape. The lack of sod and heavy use of natural mulches address the maintenance and water use considerations of the home landscape. Types of sod would certainly not be ruled out in the home landscape but thought should be given to where, when, and how it is to be used. Maintenance and space and water requirements were factors in the elimination of sod in the demonstration garden.

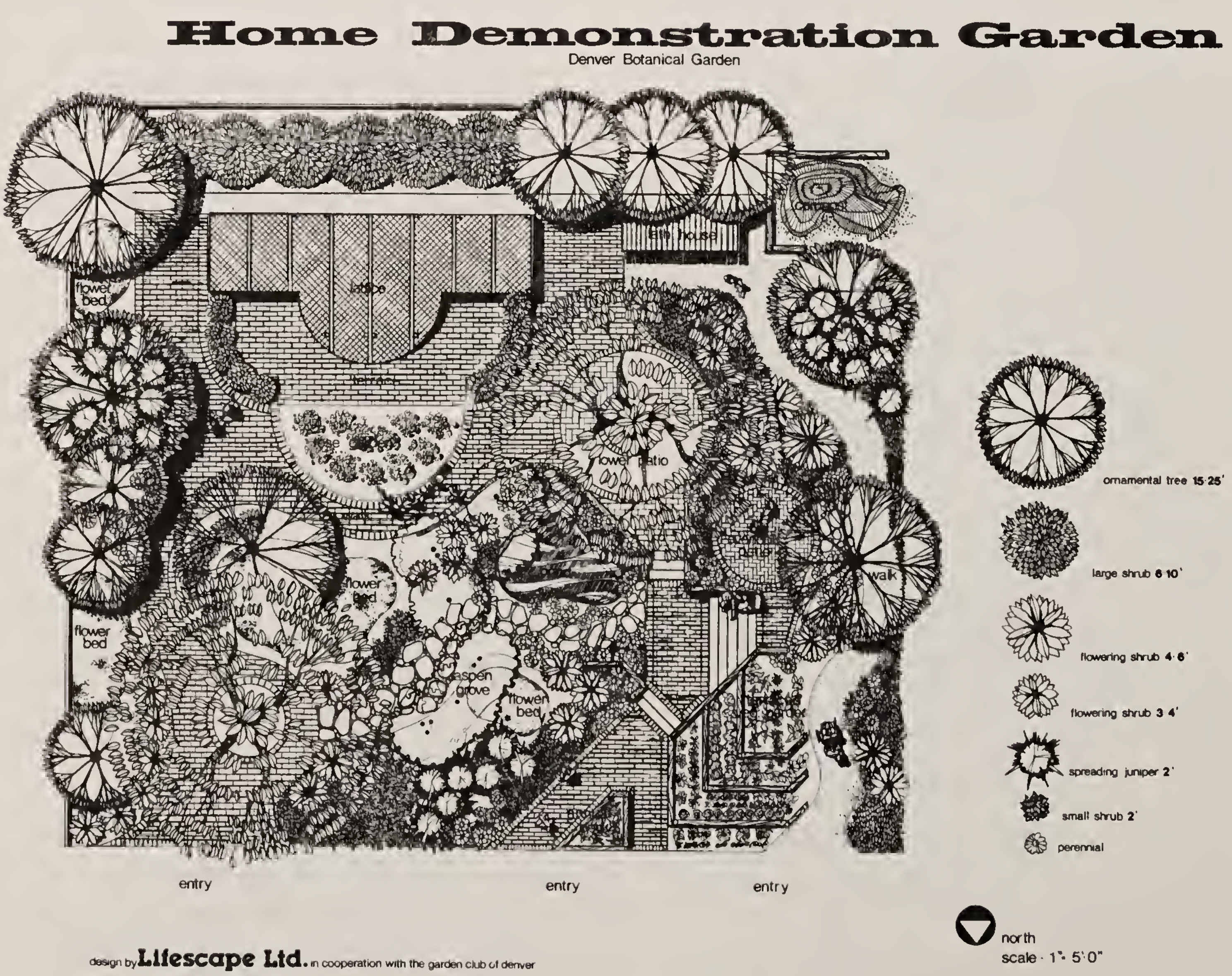
The final solution was a design that included all of the listed items. Everyone's input was used in part. The actual design, however, had no resemblance to any of the 26

original sketch plans. I must admit to extreme nervousness prior to presentation of the final plan to the Garden Club members. The design was accepted warmly and with great enthusiasm.

From the point of design approval, we proceeded to meet with individual Garden Club committees to determine types of ground covers, shrubs, trees, roses, annuals, perennials and vegetables, etc. Each committee researched its particular parcels of the garden. Again, the cooperation and input was fantastic. The Garden Club members developed the plant lists used in the demonstration garden. Selection of plant material considered hardiness, application, variety, textures and, of course, overall beauty.

With the final design complete we commenced construction in October, 1979. Construction was completed in June of 1980. A portion of the planting plan was installed during the summer of 1980, additional material was installed in the spring of 1981, with the balance to occur during the spring of 1982.

Merle Moore, Director of the Gardens, commented at the dedication of the Home Demonstration Garden on June 3, 1981: "Opportunities abound in this setting for the Botanic Gardens' visitor to carry away numerous ideas for the use of landscape building materials, garden design and plant materials suitable for the Denver area gardener."



The Phlox Adventure

Josephine Robertson

When Professor Emeritus T. Paul Maslin learned in 1978 that there might be a long lost yellow phlox blooming somewhere in Mexico, he decided to go looking for it. Such a plant had been reported almost a hundred years earlier by Cyrus Guernsey Pringle who was exploring the Sierra Madre west of Chihuahua. A 1970 article by H.L. Foster commented that if the yellow phlox could be found it could constitute a completely new color in the cultivated perennial phloxes.

This was a challenge to Dr. Maslin who started on the quest with his wife just a few months later with all the zest of any treasure hunter. The prize was not gold but a small golden flower somewhere in a rough, remote area. He had seen a type sheet of this yellow phlox at Kew Gardens and was impressed with its rich color.

In September the Maslins began a thousand mile journey in their van to Ciudad Cuauhtemoc. This was their headquarters and from here they headed some sixty miles east to Ciudad Chihuahua. Pringle had described the area as having rich open plains below low hills lightly covered with scrubby trees where he had camped. By 1978 the plains were under cultivation, the junipers and pines replaced by apple orchards and most of the rest fenced for grazing. Not much undisturbed area for wild flowers here.. After three days of intensive searching on both plains and hills, the search seemed hopeless. Both under the weather by now, they gave up and started the trip back. Three miles west of Cuauhtemoc they stopped to rest. When Dr. Maslin climbed out of the van, to his amazement, he saw in a ditch a patch of vermilion red phlox and, in the midst of it, a single yellow flower. Here at last, and when least expected, was the prize!

Because the red phlox had a bright yellow eye surrounded by a star composed of short dark red streaks and the yellow flower had a tinge of red on some petals Dr. Maslin surmised either that two species in the vicinity had hydridized or that these were two color phases of a single species.

The ground was so baked that it was hard to dig, but he collected a number of plants and the few mature seeds he could find. He guarded these with great care on the way home to Boulder.

In October of the same year Dr. Maslin and Panayoti Callas, Curator of the Rock Alpine Garden at Denver Botanic Gardens, returned to Mexico to harvest more seed and search for additional specimens.

Josephine Robertson is a freelance writer interested in garden subjects.

This time they went to more rugged country mentioned by Pringle. Since storms had washed out bridges and travel was difficult they decided to look for local advice. They showed a young man a color picture of the yellow phlox found in September. He became interested and guided them to a spot near a small lake in the wheat fields. Here again they found the true yellow phlox. Only a few flowers were still in bloom and most of the seed capsules were empty. Out of thousands of plants, they could garner only twenty-seven seed bearing capsules. They found elsewhere that both reds and yellows varied greatly in size due, apparently, to conditions of moisture and soil.

Plantings were made from the harvest they brought home, in both the Maslin garden and at Denver Botanic Gardens. The former have not flourished exuberantly, perhaps because of too much shade, but those in Denver make a spectacular display, blooming for many weeks.

Although no recorded botanist since Pringle in 1877 had seen and documented these yellow and red phlox species. Dr. Robert Bye, in 1977, discovered specimens of the latter near La Junta, Chihuahua. And so, within a year, both were rediscovered. In 1907 a German monograph by A. Brand (who had not seen the plants) mentioned both the red and the yellow phloxes which are now designated as *Phlox purpurea* (Brand) Maslin and *Phlox lutea* (Brand) Maslin. Plants of the *P. lutea* hybrids were sent to the Siskiyou Rare Plant Nursery in Medford, Oregon, where one cultivar is available to the public as Phlox 'Mary Maslin'.

The success of this quest depended on much more than luck. At the time Dr. Maslin learned of the lost *P. lutea* he was doing intensive research on *P. nana* Nutt. His love of botany began in China where he grew up near Mt. Lushan.* He looks back on himself as an eager boy naturalist, fascinated by flowers, butterflies, fish and reptiles. He set out at an early age to learn when the flowers bloomed, when they set seed and the habits of wild creatures. Although he dreamed of becoming an artist, he found a more practical way to earn a living through science. For twenty-six years he was Curator of the zoological collection at the Colorado University Museum.

His own plant collection beside the Maslin home at 819 14th Street, Boulder, is visited by many individuals and groups. In the opinion of Panayoti Callas, it is "the most distinguished private garden of its kind between the midwest and the coast." There are many alpine plants flanked by rare trees and shrubs from China. There is handsome rock work to create niches for display and beautiful rhododendrons and magnolias, rare in this part of the country. Dr. Maslin has served on the board of the American Rock Garden Society and was instrumental in organizing its Rocky Mountain Chapter. He has furnished at least two hundred plants and cuttings to the DBG Rock Alpine Garden and has helped this project in many ways, including getting down on his knees and weeding. He always contributes plants and cuttings to both the DGB and Boulder Philharmonic Plant Sales and enjoys sharing his enthusiasms.

*See "China—A Sentimental Journey" in The Green Thumb, Autumn 1981.

Dr. Maslin in his rock garden.

In his own distinguished rock garden he is not so strict a constructionist as to limit his planting to alpine stock. He prizes rarity but the artist in him emerges to place familiar annuals where a spot needs color.

"What gives me the greatest pleasure," he explains, "is to see those places in my garen where a few plants blooming against a background of rocks and shrubs create a beautiful composition."

A fuller and more scientific account of the phlox adventure may be found in Dr. Maslin's article "The Rediscovery of *Phlox lutea* and *Phlox purpurea*" in the Bulletin of the American Rock Garden Society, Spring 1979.

GREAT GARDENS IN IRELAND—I

William G. Gambill, Jr.

Slowly the British Airways plane rose from one of the runways at London's Heathrow Airport and entered the gray swirling clouds above, heading westward toward its destination in the Republic of Ireland. There had been an agonizing delay of more than an hour after those of us who were passengers had boarded. Apparently it was being debated whether Flight BA-810 to Dublin would be permitted to leave the airport, or would be an unscheduled casualty of the latest air-controller's strike which had officially begun only minutes earlier. But the plane was in the air, finally, and hopefully there would be no turning back. Later it was learned that, indeed, no other commercial aircraft had left Heathrow for Ireland that day, or the next.

Within thirty minutes the cloud cover over the United Kingdom seemed to be thinning a bit, a little later there were occasional short bursts of sunlight. Eventually the heavy clouds were left behind, and brilliant sunshine illuminated the sky and the intensely blue Irish Sea far below. The coastline of Ireland became visible some minutes later, and then in a short time the greenness of the land could be made out. Before long the plane was circling high above beautiful Dublin Bay, and in no time at all was preparing for landing in the capital city of the Republic of Ireland.

Thus began in May 1981 the second phase, Ireland, of the Massachusetts Horticultural Society's PLANT STUDY TOUR TO ENGLAND AND THE REPUBLIC OF IRELAND, led by Dr. Robert Hebb, Horticulturist at the Cary Arboretum of the New York Botanical Garden. Previous days had included a comprehensive tour of the Royal Botanic Gardens, Kew, and several hours at the incomparable Chelsea Flower Show of the Royal Horticultural Society. Half-day visits each to the garden and arboretum at Borde Hill in West Sussex and to Sissinghurst Castle and Garden in Kent also had been relished by the fifteen participants.

William G. Gambill, Jr., PhD., is Director Emeritus of Denver Botanic Gardens.

"Great Gardens in Ireland-II" will appear in *The Green Thumb,* Autumn, 1982

Visiting Irish Gardens with this tour group was undertaken without much knowledge of what one might expect to find horticulturally, and with very little opportunity to study in any depth the rather sparse accounts of gardens which were available. This participant had visited quite a number of English gardens on previous occasions and had been captivated by their great beauty, diversity and charm as well as by the large numbers of species of trees, shrubs and herbaceous plants which can be grown in them. One had learned that England is truly a country of individual gardeners who have developed their gardening skills to a remarkable degree, whether their gardens were the tiny ones of the most humble householder or the vast, carefully fashioned landscapes of the wealthy citizens. What would the gardens of Ireland be like? In the next several days some interesting answers to this question would appear.

First visits on a few days in spring to certain gardens in that country by no means qualify one as an authority on Irish Gardens. Yet perhaps a visitor may not be faulted if he attempts to describe and interpret a little of what he has seen, and express the wonder and delight which he experienced in visiting selected gardens in Ireland. It is from experiencing nine of the great Irish gardens and arboreta at first hand, and from subsequent study of some of the literature concerning them that this account has been drawn.

Climate

Why is the Irish landscape always so wondrously green? Searching for scientifically correct answers to this question brought to light some interesting facts concerning the climate and the soils of this country. Two salient features of the Irish climate provide most of the explanation: its wetness and its mildness. Consider the first of these. Prevailing winds are westerly—off the Atlantic Ocean—and they are always laden with moisture. Rainfall is distributed fairly uniformly throughout the seasons, and drought is hardly ever a serious problem. Coastal mountain areas receive more than 1600 mm (62.5 in.) annually, with other areas receiving less, down to 800 mm (31 in.) per year. Hardly any of the country receives less than 800 mm, normally. One of the most revealing statistics shows that over most of Ireland there is at least 1 mm of rain on not less than 150 days in an average year (Nelson & Brady 1979: 8-11). This is equivalent to a "natural misting system" being in operation nearly half the year.

Consider the mildness of the temperatures. This is due to the position of Ireland as the westernmost land mass of Europe, with its shores being washed by the comparatively warm waters of the North Atlantic Current. The relatively small size of the island assures that the whole country lies within the influence of the

surrounding seas. Average temperatures even in midwinter are well above freezing in most years. January is the coldest month with mean temperatures at sea level varying from 4°C (39°F) in the north to 7°C (44°F) in the southwest. Summer temperatures are fairly low with a mean in July, the warmest month, of 15°C (59°F) for most lowland areas. These figures show that there is only an 11°C (20°F) difference between the mean temperatures for the coldest month and for the warmest month in most parts of Ireland (Nelson & Brady 1979:9-10).

A third climatic factor, wind, is quite significant in the western coastal areas, particularly. Prevailing westerly winds of gale force may appear in any season, blowing salt spray quite some distance inland, resulting in scorching and blackening of the vegetation and physical damage to plants even when leaves are not present (Nelson & Brady 1979:11).

Soils

Concerning the nature of Irish soils, Edward Hyams, one of the foremost authorities on Irish gardens has this to say: "By comparison with other European countries, Ireland has little limestone and a lot of peat; the soils of much of Ireland are acid. Now while it is true that a vast number of very beautiful plants can be grown to perfection in limestone soils, and even in chalk; it is also the case that a great many of the most beautiful cannot. Not only are ericaceous plants, which include rhododendrons, with few exceptions intolerant of lime, but so are many of the finest shrubs and trees and herbaceous genera introduced from South America and Australasia. Such plants flourish in Ireland's peat" (Hyams & Macquitty 1967:24). The same authority points out that the climate and soils of Ireland are more advantageous for the growth of exotic plants even than those of England, and then makes a fine summary of the case for Irish gardens: "A large number of the most beautiful flowering plants in the world come from lower latitudes, but often higher altitudes than any part of Ireland. But the sea, warmed by the Gulf-stream, ensures for Ireland milder winters and moister summers than any other country of comparable latitude. Trees, shrubs and herbaceous plants from the hilly regions of much more southerly lands find there the mildness and the high rainfall which they need. Ireland is not by, say, Italian standards, a sunny country; but she has enough sunshine to satisfy the needs of plants which come, as the most beautiful do, from lands in which the sky is very often overcast." (Loc. cit.:22).

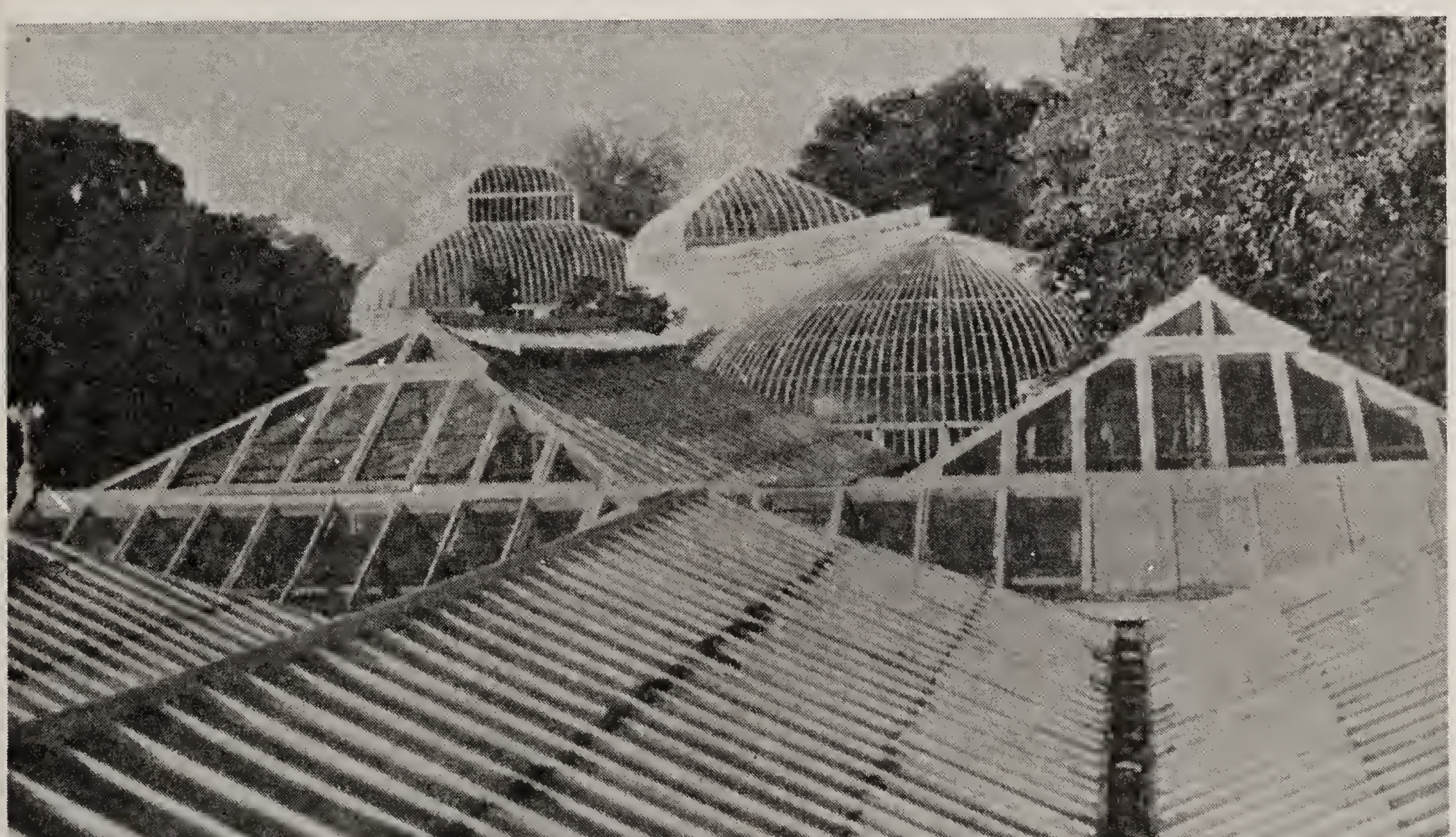
Glasnevin

The National Botanic Gardens of the Republic of Ireland located at Glasnevin, on the northwest edge of Dublin only two miles from the center of the city, in County Dublin, made a most interesting introduction to our survey of some of the great gardens of Ireland. This important national institution was founded when a resolution was passed by the prestigious "Right Honourable Dublin Society" in 1790 to start a botanical garden "for promoting scientific knowledge in the various branches of agriculture and planting, as well as to foster a taste for practical and scientific botany" (Hyams & MacQuitty 1967:144). As a result of this action the Irish Parliament soon established the garden with an endowment of L300 in the beginning, later increasing it to

L1700. Although the Dublin Society controlled the Gardens until 1880, at which time they were placed in the Science and Arts Department of the Irish Government, they have been supported by national funds since their inception. John Foster, speaker of the Irish House of Commons, was largely responsible for the early planning and execution of the Gardens. For this and many other accomplishments he is revered as a great national figure in Irish history. (Loc. cit.).

A committee purchased in 1795 the demesne of Glasnevin, only two miles north of Dublin Castle in the center of the city, consisting of "27 acres of thin loam over limestone—a thoroughly bad choice which proves that no one on the committee knew any gardening" (Hyams & MacQuitty 1969:54). Problems with the poor soil were solved in time, and a visitor seeing the impressive gardens today would not be aware of these early difficulties. Today the Gardens comprise 48 acres of gently rolling land which lie along the course of a small but picturesque stream, the River Tolka. Since Dublin Bay and the Irish Sea are nearby, the Gardens at Glasnevin receive the benefits of a maritime climate, and today are in the center of an area where commercial horticulture flourishes.

A light drizzle fell intermittently during the afternoon of our visit at Glasnevin from heavily overcast skies. This or worse proved to be the pattern for all of our garden visits in the next few days. Once inside the rather unpretentious entrance one encounters a sizable area, "The Shrubbery," planted to



The Curvilinear Range—Glass Houses at The National Botanic Gardens, Republic of Ireland.

numerous taxa of shrubs with an extensive border of early-flowering perennials. The path from the entrance leads to the Tree Fern House, a glass house with specimens of *Dicksonia, Cyathea* and other tree ferns, as well as a fine collection of ground ferns. Especially noteworthy is the beautiful display of filmy ferns (Hymenophyllaceae) which includes the rarest in Ireland, the Killarny Fern, *Trichomanes speciosum* Willd., nearly exterminated by vandals and commercial interests.

Curvilinear Plan

Nearby is the Victoria Regia House, built in 1855, in which the famous water-lily, *Victoria amazonica* Sowerby (formerly *V. regia* Lindl.), is featured along with other tropical water-lilies. A glass house for cacti and other succulents contains one of the more outstanding collections in existence. Still another group of glass houses called the Curvilinear Range, completed for the visit of Queen Victoria in 1849, represents some of the earliest pioneering designs of the renowned builder and designer, Richard Turner, working with the Hammersmith Iron Foundry of Dublin. Turner was chosen to build the great Palm House at Kew, which was begun in 1845, and which served as the inspiration for numerous others around the world. In the Curvilinear Plan the houses were made with cast-iron frames which could be curved, bent and shaped, making possible the construction of glass buildings large enough to house trees, and without internal supporting columns previously required in glass houses.

In Glasnevin's Curvilinear Range one may see a Cool House for plants not quite fully hardy, a very tall section for conifers not hardy in Ireland as well as fine specimens of *Banksia.* The Stove House, a term originally applied to a glass house heated by a stove, contains a large collection of bromeliads, and also tropical plants of economic importance including sugar cane, coffee and cocoa. The Orchid House has what was at one time the outstanding collection of orchids in the world, and still one of the best. The Palm House, more than 70 feet in height, harbors an excellent collection of cycads, palms, bamboos and tree ferns. The Camellia House has, in addition to the camellias nearly all of which are hardy in Ireland, a splendid collection of *Begonia* species as well as displays of other flowering plants in summer.

The Herbaceous Walk features outstanding herbaceous perennial beds which were most colorful at the time of this visit. The Rock Garden was in a very colorful stage, too, with numerous alpines flowering profusely, the whole unit being located advantageously with the conifer collection as a very effective backdrop.

One of the more charming areas at Glasnevin is the River Walk, where the banks of the Tolka have been planted with rhododendrons and conifers which are now very large. Near the water were colorful clumps of *Primula* and *Meconopsis* (blue poppy), along with large-leaved plants of *Lysichitum* (skunk-cabbage from northwestern U.S.). and *Gunnera,* and other plants requiring much water. Near the

The Pond Garden with *Sequoiadendron giganteum* in the background.

Tolka there is a sizable Pond Garden supporting a great diversity of handsome aquatic plants. The edges of the Pond, in turn, have been converted into a Bog Garden with numerous bog-inhabiting species from various parts of the world. The Pond is placed in a setting of magnificent specimen trees, grassy banks, curving walkways and beds of tall flowering shrubs.

Great Trees

The great trees of Glasnevin were one of the special glories of the place, remarkable for their size and age, their luxuriant growth and the great diversity of species. There is a fine collection of pines from around the world. In what is called the West Arboretum is a striking collection of maples, poplars, hollies and elms, as well as fascinating groups of birches, alders, ashes and horse chestnuts. A walk leading to the river area is sheltered by a planting of ancient, very picturesque yews. In still other parts of the Gardens there are collections of oaks, climbing vines, Chinese shrubs, leguminous shrubs, magnolias, lilacs, roses, ivies, species of *Prunus* and *Pyrus,* and bamboos. Special areas housed collections of peonies, crocuses, irises, daffodils and Michaelmas daisies. It was always a pleasure to encounter huge specimen plants of American species: American tulip, black walnut, red maple, sugar maple, western sycamore, black locust, bald cypress, American elm, eastern white pine, arbor-vitae, eastern hemlock, balsam fir, American linden, red oak, white oak, bur oak, *Sequoiadendron* (the California "Big Tree"), redwood, Monterey cypress, Douglas-fir, Colorado blue spruce, white fir, noble fir, junipers, madrono, *Ceanothus,* mountain laurel, various species of dogwood, spruces, witchhazels, sweet gum—and others.

Near the close of the afternoon the clouds lifted somewhat, and the late afternoon rays of the sun provided a rainbow toward the east, and bathed the gardens in a rich golden-green light for a short time. The contrast between this lush green garden and the sunny, arid eastern slope of Colorado's Front Range was powerful. To have verdant green gardens like these in Ireland the always-present clouds and rain are a necessity—gray, rainy days have their compensating moments in the National Botanical Gardens of Ireland.

Exotic Plants

The gardens of Glasnevin, continuously cultivated since 1795, are unique among the gardens of Ireland for their establishment to serve the purposes of economic and "practical" botany and agriculture, for the benefit of the population at large. Before the middle of the nineteenth century their dedication to serving the purposes of "pure science" also became evident. This trend resulted in the amassing of large, definitive collections of groups of plants which facilitated teaching and research in the fields of horticulture, taxonomy, plant geography and plant distribution. Glasnevin has made enormous contributions through the introduction of hundreds of species of exotic plants into the gardens of Ireland. Other great gardens in Ireland were created as horticultural masterpieces through the love of all kinds of plants, from all over the world to embellish the castles, country houses and estates by those wealthy enough to be able to do so.

Training Program

The National Botanic Gardens early assumed the role of helping in the training of young botanists and gardeners. As early as 1812 a system was developed for taking on as apprentices young men of the age of 17, for a period of 3 years, at 5 guineas a year if their work was satisfactory. Lectures were delivered by the Professor of Botany at the Gardens (Nelson & Brady 1979:106). In 1834, Ninian Niven, who had a distinguished career as a curator at Glasnevin for only five years, established a training program for young gardeners which has continued until the present time, with currently about forty such students receiving a diploma each year when they finish the course of training (Hyams & MacQuitty 1969:54). The National Botanic Gardens have served in Ireland similar functions to those performed at Kew Gardens for the United Kingdom.

References

Hellyer, Arthur. 1977. *The Shell Guide to Gardens.* London: William Heinemann, Ltd.

Hyams, Edward and William MacQuitty. 1967. *Irish Gardens.* New York: The Macmillan Company.

______. 1969. *Great Botanical Gardens of the World.* New York: The Macmillan Company.

Malins, Edward and the Knight of Glin. 1977. *The Irish Heritage Series:* 11. *Irish Gardens.* Dublin: Eason & Sons, Ltd.

______ and Patrick Bowe. 1980. *Irish Gardens and Desmesnes from 1830.* New York: Rizzoli International Publications, Inc.

Nelson, E. G. & A. Brady, Ed. 1979. *Irish Gardening and Horticulture.* Dublin: Royal Horticultural Society of Ireland.

Illustration Sources

Front cover: Drawing by Frances Frakes Hansen
Pages 34, 35: Photographs by Sandra Snyder
Pages 39, 53: Photographs by Albert E. Daraghy
Page 41: Photograph courtesy of W. W. Wilmore Nurseries
Pages 43-45: Drawings by Carolyn Crawford
Pages 46-49: Drawings by Janet L. Wingate
Page 51: Drawing by Phil Hayward
Page 54: Design courtesy of Lifescape Ltd.
Page 57: Photograph by Josephine Robertson
Pages 61, 63: Photographs by E. C. Nelson from *Irish Gardening and Horticulture,* by permission of A. Brady, Director, National Botanic Gardens, Glasnevin, Dublin.

The Green Thumb

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Do Not Fold

The Green Thumb

Autumn 1982

Vol. Thirty-nine
Number Three

The Cover
Wild Harvest
Frances Frakes Hansen

The Green Thumb
Autumn 1982
Vol. Thirty-nine, Number Three

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership — Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Newsletter*. You will also have unlimited access to the use o the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2548.

The Green Thumb

Autumn 1982

elma A. Richards
ditor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

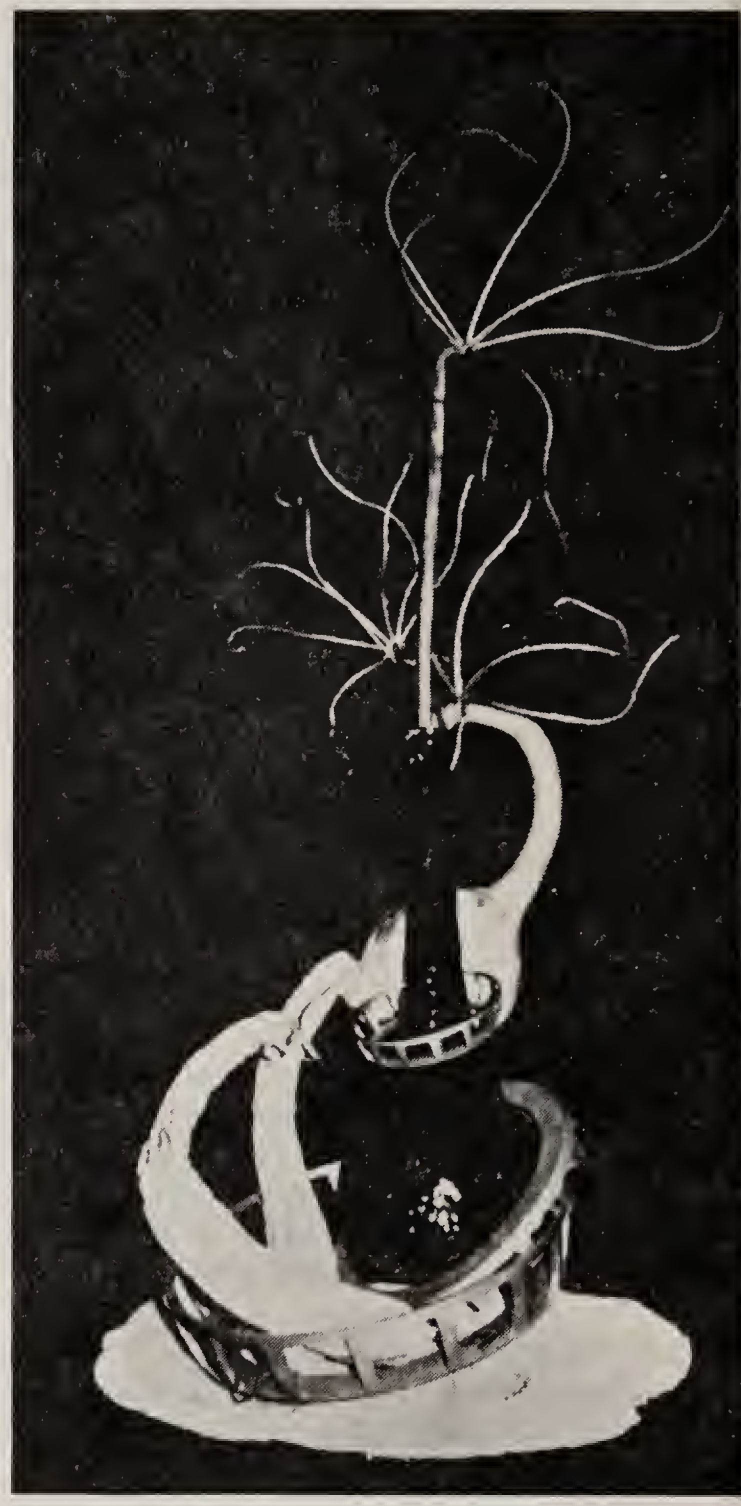
A Bounty For All Seasons

Harriett McMillan

Visitors strolling through Denver Botanic Gardens during recent months may have been puzzled by the array of raised planting beds under construction west of the large lily pond. This location, featuring a full day of sun, seems a perfect spot for the Cutting Garden.

Designed and constructed by Denver Botanic Gardens staff members and capable, knowledgeable volunteers, with many individuals providing suggestions for suitable inclusions, the garden involves a spacious, sun-filled area of approximately 70 by 80 feet that should provide optimum conditions for growing a wide variety of plants. Handsome redwood frames of varying sizes lie in a maze-like arrangement. A drip irrigation system will provide deep watering without damaging fragile blooms.

The history of art shows us that plants have always provided man with material useful as decorative accent. Collecting material for use in fresh and dried arrangements has not always involved setting aside a specific plot of ground for their cultivation. Many gardeners are unconcerned about removing choice blooms from their borders for the home, or allowing some faded blooms to ripen untidily into unique seed pods, a delight during the long winter months when there is a scarcity of design material. However, we at Denver Botanic



Gardens are fortunate to have space allotted for a cutting garden. As the name would imply, the varieties grown in these rectangular beds will be for cutting; fresh or dried, the material will be used in many ways.

The purposes for such a garden are multiple. From this garden the Around the Season Club will collect material for their annual pre-holiday sale of dried material. For 15 years this group has industriously collected and offered for sale

Harriett McMillan, president of Around the Seasons, has been an active volunteer at Denver Botanic Gardens for several years, serving in many capacities.

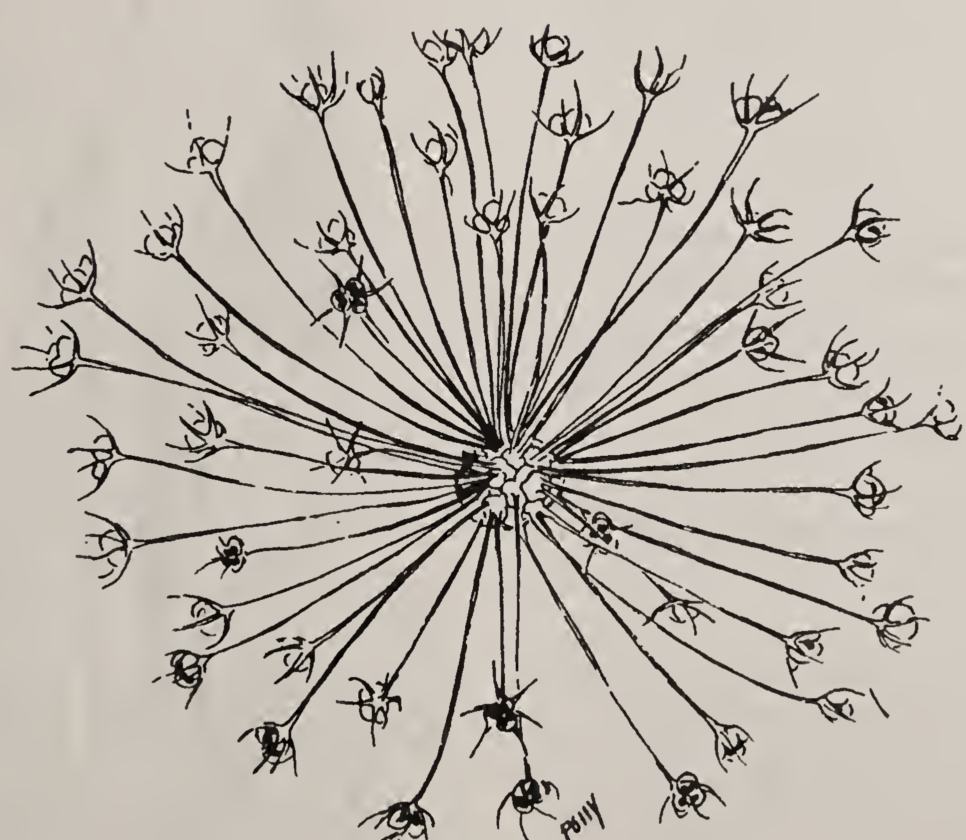
material ranging from acorns to pampas grass. They are ever-watchful for those items which provide an interesting variety of stock for their sale tables. This space will allow the growing of choice items specifically for the sale.

Others using the garden will include those fortunate students of floral design at Denver Botanic Gardens. Here they may snip at their hearts' content without the worry of depleting blooms from a display garden. The casual visitor will also benefit in observing the variety of plant material that is suitable for the above mentioned purposes, some of which they may not have considered previously.

The area will also be used to evaluate new plant material as it becomes available. A handout sheet similar to those provided in other areas will give specific information dealing with cultivation, maintenance, and harvesting.

Included in these sturdy beds will be a combination of woody and herbaceous plants. The focal point in the central bed is a twisted hazel, also known as Harry Lauder's Walking Stick, the delight of flower arrangers everywhere. Quantities of annual blue salvia, strawflowers, yarrow, grasses and other everlastings will abound. As well, you will encounter pussy willows, privet, and occasionally, ornamental gourds. Many of the plants which provide choice items for drying are also useful as fresh cut flowers.

This year's harvest will be limited due to construction still in progress. However, additional perennial and shrub plantings should take place this fall. Maintenance of the Cutting Garden will be a project of the Around the Seasons Club. This summer's work has been overseen by a mother duck and her three ducklings who inhabit the lily pond and adjacent Japanese Garden. Their unconcerned roaming provided cheerful and entertaining companionship for the volunteers. This was the first of what will be many seasons to come for the Cutting Garden; its future will hold a bounty for all visitors during all seasons. ■



November Magic

Sydney Glick

Twelve Novembers have passed since I came to live in Denver and twelve "Christmas Sales" at the Denver Botanic Gardens. I remember the feeling the first year I worked at the dried plant section of the sale that the incredible array of acorns, nuts, berries, seeds, pods, fruits, dried weeds, dried flowers, grasses, wood bits, glycerined leaves, and twisted stems had all been conjured up by some sort of magic. Such a wealth of variety in form, texture, and color!

That same feeling returns every year I work on the sale but now I know it is hard work and thoughtful effort which provide our bounty—not magic. It takes know-how to end up with quality products which people flock to buy each November. Picking flowers just when they are going to be best for drying, or plucking grasses from their sheaths early enough, or picking cattail heads in July before most people think about winter bouquets they'll assemble in the fall—these are the tricks experience teaches. You have to know what to collect and when, and then what to do with it after you have found it. The Around the Seasons Club members at the Denver Botanic Gardens who have been providing these materials for the sale for 15 years have apparently learned all this, for the sale seems to get better every year.

These women are also blessed with tolerant families. They have come to accept the yearly stuffing of all corners of the family garage with stems of pussy willow, large sprays of lunaria (our wonderful "honesty" or "money plant" which has to dry some weeks before being readied for sale), large bundles of field grasses, tall round allium heads, strings of highly pungent (and sometimes sneeze-producing) sages, and later on, heads of wild sunflowers, gum weed and fire weed, rabbitbrush and

Sidney Glick, an active volunteer at Denver Botanic Gardens, and, also employed in the Administrative Office, has served as president of both Associates of Denver Botanic Gardens and Around The Seasons Club.

teasel. Back porches, patios, unused bedrooms and sometimes well-used family rooms are also pressed into service as the season progresses. So, too, are dark, cool basements, airy work rooms, attics and lofts where flowers like blue salvia, sulphur flower, strawflowers, celosia, xeranthemum, hydrangea, sea holly, scabiosa, etc., etc., can be hung to dry. Finding storage room for drying is always a problem as most families are only so flexible in sharing their space. For the past few years we have even pressed into service the seasonally empty corners of the Helen Fowler Library basement (at other times fully occupied by the books for the annual May Used Book Sale). Tolerant librarians are a blessing, too.

And where do all these flowers come from? Some, of course, are wild and can be harvested along deserted roadsides and in fields and meadows outside the National Forests or other restricted lands. Over the years we have learned to seek out these likely spots where favorite flowers and seed pods grow and no harm is done in the picking. Some plants we grow in our home gardens, in our neighbors' gardens, our mothers' gardens, and our kids' gardens. Some of the plants grow at Denver Botanic Gardens and can be judiciously harvested as displays permit.

Some of our "finds" come from our travels or from friends or relatives who live in far-off states. We get earpods from Florida, sweet gum balls from North Carolina, hemlock cones from Ohio, sugar pine cones from Oregon, and protea and wood roses from Hawaii. We have been lucky, too, to know people whose mountain lands yield squirrel caches of cones and nuts which can be raided in years of plentiful harvests. Osage oranges we used to pick off the ground across the street from the Botanic Gardens. Now the trees are in the Community Gardens but we still pick the fruits off the ground—the thorns on those trees now being better nourished, if anything, and more formidable than ever!

Would you believe we dry and sell artichokes and okra, carrot flowers gone to seed, calices (the brown collar around the stem) of persimmons, dry peach and prune stones, walnut shells, and thistles? And our prices are very reasonable—like 3 acorns for 5¢, a penny for a stem of grass, 10¢ for beautifully glazed baked pinyon cones. Money plant sells for anywhere from 50¢ for a small bundle of short stems to $8 or $9 (our highest prices) for a large, magnificent bundle.

This year we have the first plants from our new Cutting Garden at Denver Botanic Gardens. The range of sizes and colors of dried flowers will be greatly enhanced as we gain experience in this new venture—learning what to grow from the new developments and improvements which are constantly becoming available. Old favorites will also be planted so we can harvest them at the best possible times. Volunteers from Around the Seasons are busy tending this garden and drying its harvest.

The money raised by the sale of these dried materials goes back to the Gardens. Some of the funding for the new Cutting Garden was raised from this project, as was the support of a hearing-impaired student at the Gardens during the past three summers, the planting of some oak trees and perennials in the Gardens, and plantings around the new Visitors' Center at Chatfield Arboretum.

The November Holiday Sale will be here again soon. I look forward to its excitement, its wonderful variety—its magic! ■

Art and Artists, *The Green Thumb*— Frances Frakes Hansen

The distinctive artistry of Frances Frakes Hansen has graced many covers of *The Green Thumb* magazine during the past six years.

A painter and designer, Mrs. Hansen was professor of art and director of the art department of Colorado Women's College for many years. She also taught at the University of Denver.

She grew up in Colorado where she earned a Bachelor of Fine Arts degree at the University of Denver and a Master of Arts at the University of Northern Colorado. She did special study at the school of the Art Institute of Chicago and the Ecole des Americains at Fontainbleau, France, with doctoral work in art at the University of Southern California.

Besides her volunteer work at Denver Botanic Gardens Frances has served five years as a volunteer doing research and designing displays for the development of the American Indian Hall at the Denver Museum of Natural History. Recently she illustrated a book of poems, *Song of the Ghost Trains*, published by the Denver Symphony Guild. Her paintings, drawings and designs have been exhibited locally, regionally and nationally. She is listed in *Who's Who in American Art* and had a charter listing with subsequent listings in *Who's Who of American Women.*

With her husband, Claude B. Hansen, also an artist and writer, she designed the seal for Colorado Forestry and Horticulture Association, predecessor of Denver Botanic Gardens. ■

BEP

Plant Hunting In the Orient

Kim Sorvig

China: Land of Mystery, Mother of Gardens, Oldest Civilization, Hope of the Future. China has been called all of these, none of them without good reason. In September 1981, thanks to the international interest which people share in plants, I was able to visit a remote area of China, a dream which I had cherished for years. The object of this visit: to collect plants in the mountains of the Chinese-Tibetan borderland.

The expedition was very much an international operation. Organized in Britain and led by the internationally known plantsman and ex-curator of Hillier's Arboretum, Roy Lancaster, the group included botanists, horticulturists, and "keen amateurs" from five countries. I became involved by way of my studies at the Royal Botanic Garden, Kew, when Mr. Lancaster gave a lecture there describing a previous visit to Mount Omei in Sichuan Province.

After writing what seemed like millions of letters, winning some support from Kew and some from outside, and hocking myself up to the ears, I found myself actually en route. Our eventual destination was to be the area around Minya Konka, one of China's tallest peaks, located to the west in Sichuan Province, at about 101° E and 29° N. That particular area had only been seen by one foreign botanist: Joseph Rock, in 1929.

Our journey took us through Hong Kong, Guangzhou (Canton), Chengdu, the capital of Sichuan Province; and then by road into increasingly rural and mountainous areas. And as if an un-botanized, remote haven weren't enough excitement, there was a great deal to be seen along the way of botanical, horticultural and ecological interest.

In Hong Kong we were met by the four Americans, other than myself, who had come across via the West Coast to meet our flight from London. Paul Meyer, curator of the Morris Arboretum, and Peter Bristol, of the Holden Arboretum, were proceeding to Korea after our expedition, while nurseryman Tim Brotzman and landscape enthusiast Steve Morris would be returning to the Midwest. It was a pleasure for me to meet some American colleagues after two years in exile.

The "Soft Seat Through Express" took us across the border into Canton, where we stayed in a magnificent tourist hotel, complete with Space Invader machines and Coca Cola. While waiting for our flight to Chengdu, we were able to shop—among other things for botanical books—and to visit several gardens.

Kim Sorvig, a former volunteer tour guide at Denver Botanic Gardens, has recently completed 3 years of study at the Royal Botanic Garden, Kew, England, and will be returning to Fort Collins to do freelance horticulture and landscaping.

Canton Gardens

Two of the Canton gardens were scientific collections: the South China Botanic Gardens, located on the outskirts of the city, and the Ding Hu Shan Biosphere Reserve, some 50 miles away.

South China Botanic Gardens is a large collection, beautifully landscaped with royal palms (*Roystonia regia* Cook.), centering on a lake and pavilion. I had met one of the men responsible for the design when he was on exchange at Kew, and it was interesting to see his work. Special collections of tropical ferns, medicinal plants, and bamboos were also noteworthy, and I would highly recommend a visit to anyone going to Canton.

Living Fossils

Ding Hu Shan, or Seven Star Crag, is a reserve created on the site of an ancient Buddhist monastery, and administered jointly by UNESCO and South China Botanic Gardens. The monks preserved this holy mountain from being stripped for firewood and cultivated; it was also such monks that preserved that curious living fossil, the maidenhair tree (*Gingko biloba* L.), from extinction. After being served a sweet pink tea made from dried leaves of *Begonia fimbristipula* Hance, we climbed a damp, slippery path up one of the crags. Among fishtail palms (*Caryota ochlandra* Hance) and *Pinus massoniana* D. Don, which was tapped for resin near the reserve, we saw another species which is virtually a living fossil: *Cycas rumphii* Miq., one of the cycads, common in dinosaur days and in some ways half tree-fern, half conifer. Here it was growing wild among the tiles used in repairing the monastery.

We also visited the small Orchid Garden in Canton, landscaped with exceptional subtlety, and once we reached Chengdu, were able to visit the Bamboo Garden. This is totally devoted to a group of plants about which I am mildly fanatical, and included such oddly-named species as chicken-foot bamboo or human-face bamboo, and a beautiful clump of *Lingnania chungii* (McClure) McClure, a bamboo with powdery white stems.

Chinese Agriculture

As we left Chengdu, in two minibuses with a jeep and one of the universal "army-style" trucks, we saw a great deal of Chinese agriculture. Sichuan, apart from its peppery food, is known for its rice in much the same way as our "breadbasket" states; and we arrived in the midst of the harvest. Using technology on a small scale, conserving space by growing squash and melons over the tile-roofed houses, and recycling sewage both as fertilizer and through the use of methane digesters, the Chinese continue to feed their huge population without reducing their land to sterility. In the same area we passed by the recently-formed reserve of the Giant Panda.

Plant Collectors

Once we left Chengdu, botanizing and collecting began in earnest. Traversing the route along the precipitous valleys of the Dadu Ho, through the towns of Ya-an, Hanyuan, Luding, and Kangding, we climbed gradually higher and higher, and passed through the rapid progression of habitats which have made the Himalayas, both here and on the Nepalese side, such a mecca for plant collectors. Two of those best known in America were

Joseph Rock and E. H. Wilson, who worked for and then succeeded Charles Sprague Sargent as the Curator of the Arnold Arboretum. Interestingly, one of our members was the great-granddaughter of Professor Sargent.

Sorvig collecting birch seed

The mountains of China are magnificent, their misty profiles seeming to contain more space than earth itself. They are also very prone to landslides. One of these delayed us, near the commune of Shi-mian, for seven hours. However, botanists are lucky in that their work or hobby is always at hand, and we made use of the stops to explore the vegetation—and for welcome relief from the Chinese roads! One very interesting plant discovered during such a stop was *Keteleeria davidiana* Beissn., a rare conifer which bears its cones in pairs held upright at the tips of the branches, like candles ready-made for Christmas. Here, too, were species of *Bauhinia* in flower; this is a widespread genus of trees, shrubs and climbers in the legume family with distinctive leaves shaped like a cloven hoof. Three species of evergreen oaks and many lily bulbs, including those of *Lilium sargentiae* E. H. Wilson collected by Wilson and named for Sargent, also delighted us.

Botanical Curiosity

There is a botanical curiosity in this area that was of particular interest to me as a Coloradan. I thought at first I was hallucinating or homesick when I saw prickly-pears all over the hillsides. The rain-shadow side of the hills provided a suitably dry environment; but *Opuntia*, like all cacti, is strictly a New World genus.

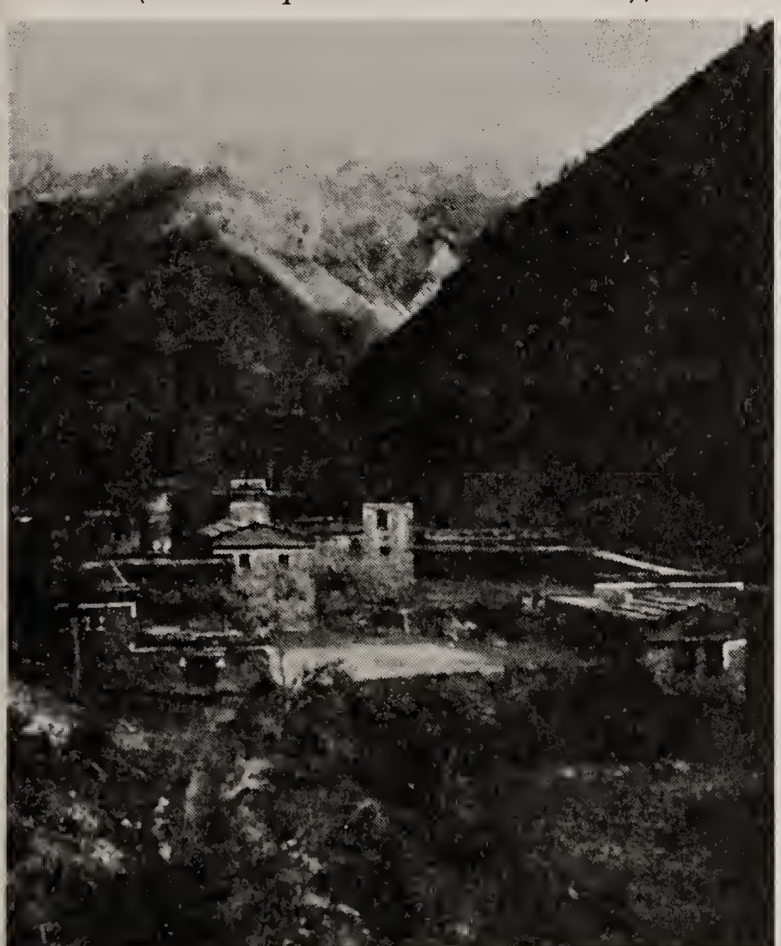
It was not until I got back to Kew that I was able to get a complete explanation for this. At a party one evening I happened to mention it to a taxonomist from Kew's herbarium, who knew the answer. The Spanish brought the prickly-pear back from their colonies, along with the knowledge that it is edible. By way of the Moorish people, the plant passed into the dry areas of the Arab world. These same Muslim traders traveled the overland silk routes to China, where some of them settled, cultivating *Opuntia* for the table and for use as a hedge. The climate was favorable; it escaped and was recorded as naturalized by Wilson seventy years ago.

Tibet

Above Kangding, the Gateway to Tibet (known to Wilson as Tachien-Lu), we crossed a pass of some 4500m altitude, and entered an area that was geographically and culturally Tibet, whatever the politics of the situation. Yak herds in black, beetle-like tents shared the upper pass with people in beautiful stone houses, fort-like but brightly decorated. On the pass the main vegetation was a shrubby rhodedendron,

among which we found shrubby honeysuckle (*Lonicera thibetica* Bureau & Franch.) gentians in profusion, and a particularly exciting discovery: *Meconopsis integrifolia* Franch., the yellow Himalayan poppywort, which was the object of Wilson's second expedition, about 1910, and which he, too, found for the first time near this pass.

Now we came to territory unknown to Wilson, and eventually made camp near the tiny Tibetan village of Luiba, where we spent the main part of our stay. Altogether, the expedition members must have collected more than 500 species of plants, some well known, some unknown. The area was dominated (depending on the altitude and exposure) by several pine species, a shrubby evergreen oak (*Quercus semicarpifolia* Sm.), and the Himalayan birch (*Betula utilis* D. Don) of which we saw several forms with glowing, cinnamon-red bark. A lichen (*Usnea*) resembling "Spanish moss," draped many of these trees. Larch (*Larix potanini* Batalin.), two



Tibetan village near Minya Konka

species of tree-sized juniper, several different wild apples and mountain ash (*Sorbus*) species, and *Hippophae salicifolia* D. Don, a relative of the Russian olive, with bright orange, edible berries were among the common trees.

There was an abundance of smaller plants, from the two species of shrubby honeysuckle to tiny louseworts and gentianellas. Clematis (nearly 20 different species or forms), roses, and cotoneasters were particularly well represented. One of the cotoneasters (*Cotoneaster microphylla* Wall. *ex* Lindl. var. *cochleata* (Franch.) Rehd. & Wils.), a prostrate shrub with bright red berries, resembling our kinnikinnik, had tiny, scalloped leaves which were rimmed with frost on several mornings. It will make an attractive garden plant if our seeds germinate. Many of the herbaceous plants were past flowering, but there were so many gentians (someone counted eight species), edelweiss, late primulas like *Primula sikkimensis* Hook., dianthus and others that it could have been springtime.

Our last day at the campsite provided us long-awaited clear weather and a beautiful view of Mount Minya Konka, which rises to 24,970 feet and was held to be one of the most sacred sites in the world. The seed which we were able to bring back will be of interest to botanical gardens since it is from verified natural source, as well as to horticulture as a source of new genetic diversity and vigor. Hopefully it will also contribute to the ecological knowledge needed for sound policy and planning, and also to the spirit of international cooperation that plants have evoked since the days when people still recognized the holiness of mountains like Minya Konka. ■

New Trends in Chinese Botany

K. H. Shing

Research in plants has a long history in China. More than a thousand years ago a book named *Shen Long Herbal* appeared. Up to the 15th century, there continued to be many herbals published. The most famous is the *Compendium of Materia Medica* by Li Shi Zhen, who collected specimens and investigated herb use. He summarized the experiments of his predecessors and corrected their mistakes. This book is not only a comprehensive summary of all pharmacological knowledge up to that time, but also includes many valuable illustrations.

Dr. Shing

With the efforts of the senior botanists such as Professors Chien Sung-Shu, Hu Hsien-Shou, Chun Woen-Young and others, the study of modern taxonomy was gradually launched in China. These botanists went to Europe to examine the plant specimens which foreign botanists had collected in China. For example, Professor R. C. Ching, a member of Academia Sinica and the advisor of the Institute of Botany, visited Copenhagen in 1930 and began seriously to carry out a study of Chinese ferns under the direction of Dr. Carl Christensen. In the fall of the same year, he participated in the Fifth International Botanical Congress at Cambridge. There he met many leading pteridologists from the United States, Germany, England and other countries. After the congress, he stayed at Kew for over a year, not only working on Chinese and Himalayan ferns but also taking photographs of all the type specimens of Chinese plants. This effort laid the foundation for the development of Chinese phytotaxonomy. These botanists, including some from other countries, continued to make many collections in various parts of China. This was especially so after 1949, when the Institute of Phytotaxonomy of Academia Sinica, now called The Institute of Botany, was established. The Institute organized many expeditions to the southwest, west, northwest, southeast and south of China in such areas as the Yellow River, Xinjiang Province, Changbei Shan, and Hainan Island.

K. H. Shing, Ph.D., a Research Associate and Curator of the Fern Herbarium of The Institute of Botany, Academia Sinica, has been a pteridologist since 1957. He was a visiting professor in the biology department at the University of Colorado in Denver for the 1981-82 term.

One of the largest expeditions was for the general investigation of economic plants which took place throughout the country in 1958 and culminated in the publishing of *The Flora of Chinese Economic Plants.* Another was the Complex Expedition of the Chinghai-Tibet Plateau, still in progress, which has led to the publishing of *The Flora of Tibet.* An international symposium on the Chinghai-Tibet Plateau was held in Peking in 1980. Many scientists from all over the world who were interested in this area took part in the symposium.

These expeditions resulted in an increasingly rapid accumulation of specimens. At present there are more than ten times as many specimens extant in Chinese herbaria than there were before 1949. Approximately 1,500,000 sheets of specimens of vascular plants are in the herbarium of the Botanical Institute in Peking alone. This collection has now reached the status of being one of the outstanding herbaria in the world. With 130,000 sheets of ferns, the fern herbarium is the principal collection of Asian pteridophytes. The moss herbarium has increased nearly five times since 1949 with more than 50,000 specimens.

In the past 20 years, although the development of science was interrupted during the rule of the Gang of Four, Chinese phytotaxonomists have persevered. They have edited the *Iconographia Cormophytorium Sinicorum* consisting of five volumes describing 8000 species—a very useful manual for identifying Chinese plants. Approximately a third of *The Flora of China* has been published. This is a vast task amounting to a total of 80 volumes. At present it is estimated that it will be finished in 1985.

Recently there has been a gradual transition from classic phytotaxonomy to biosystematics; from pure morphology to combining cytology, biochemistry, genetics and numerical taxonomy. The scanning electron microscope has been used to compare surface structure of pores and pollen grains. Also, computer science has been introduced into this field. About 10 percent of the botanists from the Institute of Botany have worked abroad, most of them in the United States, to learn new techniques and theory, thereby hoping to gradually raise Chinese phytotaxonomy to the molecular level. Next year, the Institute Herbaria will move to Xiang Shan west of Peking where the Peking Botanical Garden is located. A new building, the Chinese National Herbaria, will be set up on the grounds of the Garden. With an available area of 1000 square meters, there will be adequate room to receive botanists from around the world who would like to look at the specimens there.

Dragon Gully Ravine

Even though great progress has been made, it is just the beginning. Much more must be done, especially in collecting specimens. China encompasses a vast territory varying from cold temperate to tropical zones. Therefore, her plant resources are very abundant. For various reasons many places have never been investigated. Last year, for example, because of an increase in tourism Dragon Gully Ravine was discovered just 30 km from Peking, where water flows in the gully even during the driest seasons. The scenery is so beautiful here that if one does not look carefully at the plants, a person might think he were far south of here in the Yangtze Gorges.

Even more interesting are the three new records of ferns in China in the last three years. *Adiantum reniforme* L., simple maiden hair, which was only known in the Azores Islands in the Atlantic Ocean, now is known to be interruptedly distributed to eastern Szechuan in China. As there are differences between the Chinese and the Azores species in form and indumentum, Lin Yu-Xin has named the Chinese form, *A. reniforme* L. var. *sinense* Lin (Acta Phytotax. Sin. 18 (1): 102.1980). Another recent discovery is the first record of the genus *Platycerium Desv.*, the staghorn fern, ever found in China, within the border of Yunnan Province near Upper Burma. The third record is of *Phyllitis scolopendrium* (L.) Newm., the hart's tongue, found by a country doctor in Changbei Shan of Kirini Province in northeast China, though we have had many botanical expeditions to this area in the past. This discovery completes the range of distribution of this species from Europe to Eastern Asia.

It is evident that Chinese plant resources must be further investigated, especially the ferns. Because many ferns inhabit special environments such as precipices and ravines, collecting them is very difficult, sometimes dangerous. To one who does not have a specialized knowledge of ferns, many different ferns look like the same species. Because of this, some species have been overlooked in the field. Certainly more new plant species will be found in China. How to carry on the expeditions more perfectly is still our important task. ■

Chinese Maiden Hair Fern

Plant Hairs

Miriam L. Denham

When plants are looked at closely, we see that while some, especially many house plants and those used commercially for interior decoration, are smooth and waxy on the surface, others have a "fuzzy" texture. The original interest in African violets, when there were only plain, purple and pink, single blossoms may have been sparked by the different kind of leaf.

What is it that gives this "fuzziness" on the surface of the leaf? If we look closely at many different kinds of plants, we see short or long, thin or thick, hair-like processes known as trichomes. The term trichome comes from the Greek word, *thrix* or *trichos,* for hair plus the suffix, *-om,* meaning body. These plant hairs or trichomes are formed as outgrowths from the plant's outer cellular layer, the epidermis—not from any subepidermal tissue such as the mesophyll or vascular tissue. The prickles found on roses and currants (*Ribes* spp.) may be similar in their origin and may be truly trichomes or may have subepidermal tissue present and be classified as emergences. The limits of the term trichome are not always sharp, and botanists will differ in their choices. These prickles may be contrasted with thorns on the hawthorn and locust which are not trichomes because they are derived from short stems that have veins or vascular tissue inside, as do all branches.

Miriam L. Denham, Ph.D., biology teacher in the Division of Continuing Education, University of Colorado, Boulder, has done extensive work on the taxonomic significance of trichomes. She is working with her husband, Dale, on the collection and identification of plants of Colorado.

Trichomes may grow on all parts of the plant. They are most evident on leaves and stems, but can occur on flowers and roots (root hairs) and have even been reported to occur on intercellular spaces inside plants (Uphof, p. 8).

With the exception of root hairs which absorb water and dissolved minerals, the functions of trichomes are obscure. Trichomes are present in great diversity on many different kinds of plants. Some plants have none; some have only one kind of trichome; others have several different kinds.

Functions

Trichomes are commonly divided into two major categories: ordinary cover hairs which are commonly believed to be somewhat protective in function; and glandular hairs which usually have an obvious secretion associated with them. They are most evident on young parts: buds, leaves, stems. Here the function seems to be for protection, as often the soft young parts are very hairy and these hairs are lost as the parts mature and the tissues harden. Trichomes of the leaves, probably the best studied, are formed and are usually fully developed in the very small, young leaf.

In many plants such as those in desert and alpine areas where the density of hairs seems to be associated with protecting the organ from drying out or from the heat of the sun, we can compare the hairiness of the same kind of plant as it grows in the hot, dry sun with how it grows in the cooler, more humid

shade. It is immediately evident that a plant with white hairs in the sun may be green and lacking hairs in the shade. Similarly, a few plants have been observed in which the density of hairs was directly correlated with the weather at the time the leaves were formed: densely hairy leaves formed during dry weather and less hairy leaves formed during wet weather—both kinds of leaves being found on the same stem. The question needing further study is: Are hairs formed more freely because of the water stress on the plant during dry weather, or are the hairs formed to protect the plant from the dry weather?

In Colorado, the change from densely hairy when young to the loss of hairs when leaves are mature is easily seen in members of the genus *Senecio.* Some *Senecio* species retain some hairs throughout the growing season, others tend to lose them with age. These tendencies are quite stable within a species and can be used to determine a species of *Senecio.* This is also true of many other taxa.

The term taxon is a convenient one to use. It is a non-specific word which can be used to discuss an unspecified group of related plants. In other words, when we use the term taxon we may be speaking of members of a species, members of a genus, or members of any other category. But we know the group under discussion is related.

Diversity

Trichomes come in a tremendous diversity of form. At one extreme is a small protrusion of an epidermal cell wall which may be termed a papilla as in the leaf of the coca plant, *Erythroxylum coca* Lam. (Uphof, p. 19) or the leaf of *Rhododendron pubescens* Balf. f. & Forr. (Cowan Pl. I). At the other extreme may be multicellular, tiered hairs as in mullein (*Verbascum thapsus* L.). Multicellular, irregularly branched trichomes in *Nicotiana trigonophylla* Dun. (Goodspeed, Fig. 25) exhibit several different types of cells in both shape and contents and, also, some branches with ordinary tapering cells to the tip and other branches terminating in several-celled glandular heads.

In the mustard family, Cruciferae, most trichomes are composed of only one cell, but that cell is a simple tapering cell in some taxa; an antler-shaped (dendroid) cell in another (basket-of-gold, *Alyssum saxatile* L.); a pick-shaped or T-shaped (dolabriform) cell which is attached in the center rather than at the end in another, (wallflower, *Erysimum asperum* (Nutt.) D.C.); a stellate-branched cell which may have the rays variously completely separated or more or less fused according to the species as in the bladderpod (*Lesquerella* spp.) and double bladderpod (*Physaria* spp.). Here, when the rays are completely fused, the hair becomes a peltate scale but still a single cell.

Some very similar simple, stellate, or stalked, tufted hairs are to be found in many members of the mallow family, Malvaceae, but here the hairs are composed of many cells, multicellular, instead of being a single cell.

Identification Tool

In each case the kinds of trichomes present are constant. Sometimes a trichome form is unique and can be used to determine a particular taxon. In that case we say the trichome is diagnostic. In other cases the trichome is an additional tool which may be used in identification.

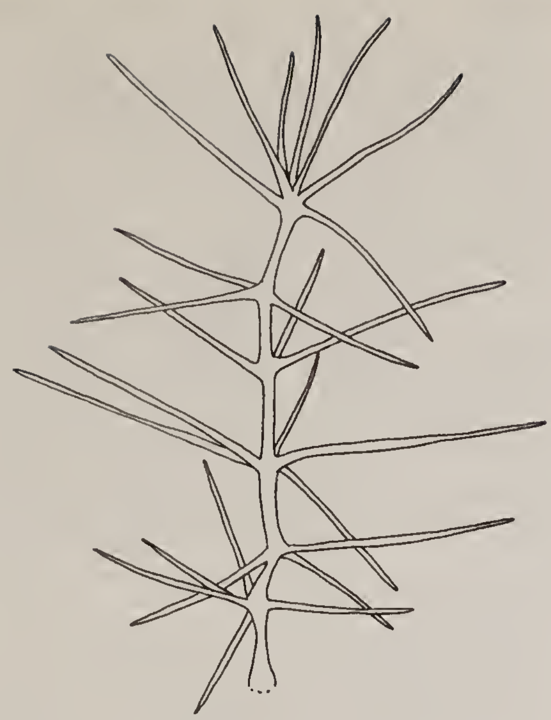


Fig. 1. Tree-like multicellular hair of mullein

When we see so many different kinds of plants covered with hairs, and we see so many different kinds of hairs, we wonder what value they have for the plant. Although for some plants we seem to have found an answer, for others the purpose is unclear. Experiments have determined that the function of the hairs may differ if the hairs are living when the leaf or other plant organ is mature or if the hairs are dead. Living plant hairs can be demonstrated to contain cytoplasm and nuclei which can be stained to emphasize their presence, and sometimes green chloroplasts are evident. Living hairs increase the surface area of the plant; if the hairs are dead, the living cells on the surface of the plant are sheltered. Dead cells may be empty and air-filled or sometimes filled solid with calcium carbonate or opalescent silicates.

A good way to examine trichomes is to take a leaf, bend it over your finger to separate the trichomes somewhat and look at them silhouetted against the light. The larger hairs are easily seen with the naked eye or with a small hand lens. On many plants the largest hairs—hence the ones most easily seen—are on the larger prominent veins on the underside of the leaf.

The common mullein (*Verbascum thapsus* L.) is densely covered with large, branching, tiered, tree-like multicellular hairs with the cells arranged more or less in a single file (uniseriate, one series). These fascinating hairs are already dead by the time the young leaf is one-half inch long—long before the leaf is completely expanded or mature. The accompanying diagram (Fig. 1) is that of a typical trichome from a young leaf. In the mullein, probably the most important function of the hairs is to protect the plant from drying out. If you can visualize the candles of yellow blossoms in summer followed by the brown seed stalks growing in the hot sun along the dry, gravelly edges of roadsides, you can see the value of hairs forming a protective micro-environment to keep the hot, dry air of summer from damaging the plant. This dense cover of dead hairs reduces the air movements across the surface of the living cells, both slowing the air currents close to the plants and providing a more humid layer of air within the hairy covering.

As mentioned above, in the mallow family we often find star-shaped or stellate hairs. In the common hollyhock (*Alcea rosea* L.) some of these hairs are also large and easily seen.

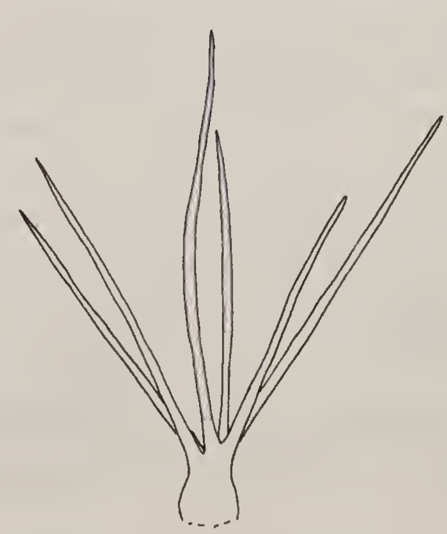


Fig. 2. Stellate (tufted) hair of hollyhock

They arise from a small pedestal and have several (2-8) needle-shaped cells branching out from that point, a tufted arrangement (Fig. 2). These trichomes are also dead when the leaf is mature.

By contrast, the trichomes of the African violets (*Saintpaulia* spp.—mostly *S. ionantha* H. Wendl. [Wendland] hybrids) are living when the leaf is mature. Their function is obscure. The trichomes often form a small micro-climate area. They could act to keep water from condensing on the surface of the leaf—the droplets of dew forming instead on the tips of the hairs. Since some of the plants are found in cloud forests, this could also be a means for the plants to gain additional moisture from the clouds. Also, since carbon dioxide dissolves readily in water, it is possible that carbon dioxide could accumulate at night and be available for the plant to use for photosynthesis in the morning. *Saintpaulia diplotricha* B. L. Burtt (double-haired) is one of the African violets with a very simple pattern of hairs on the leaf (Fig. 3). Evenly

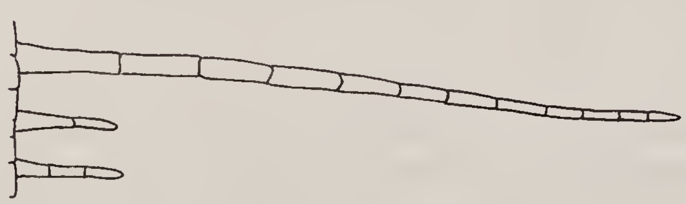


Fig. 3. Double-haired pattern of *Saint paulia diplotrichia*

scattered over the leaf surface are erect, long (about 2mm), uniseriate trichomes consisting of about a dozen cells. Beneath these are more numerous short hairs (about 0.1mm) consisting of 2-3 short cells about the length of the bottom cell in the longer hairs. These form the double-haired pattern—the "trichome complement" of Sherwin Carlquist.

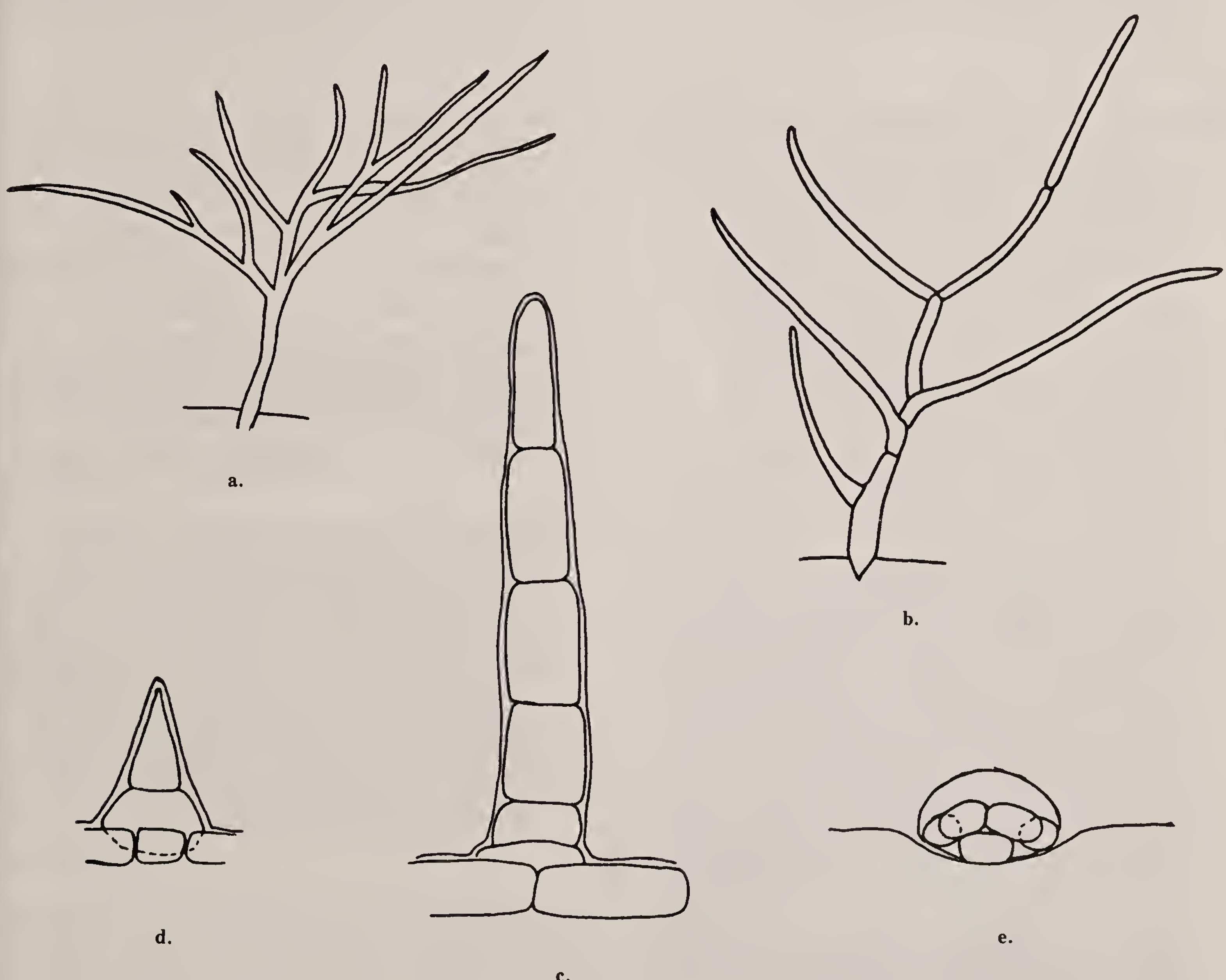
Density

In Colorado, most of our hairy plants are found in the drier places—on the plains and on the mountain tops—and the drier the environment, the hairier the plant becomes. David B. Dunn (Personal Communication, 1969) stated that he believes in the plants studied, he and his co-workers have conclusively proved that trichome density is an environmentally dependent character, the density increasing with increasing aridity and increasing light intensity. However, at least one African violet relative from India, *Aeschynanthus* spp., has fairly waxy-surfaced, smooth leaves which become hairy when the plant has extra water. Here the hairs seem to be a means to increase the area of the leaf to get rid of moisture—still a response to the environment, but probably ultimately under genetic control.

Although there are numerous kinds of trichomes, they are uniform within a given taxon and may be used to assist in identification of plants. Trichomes and other surface features are covered with cuticular waxes which are resistant to decomposition. Herbarium specimens which may be two hundred years old will usually show good epidermal characters. Also, epidermal characters of plants are among features which have been found well-preserved as fossils. Dr. R. M. Hansen at Colorado State University has made a study of plants eaten by domestic animals using trichomes and other structural features for identification. Dr. Olwen Williams, retired from the University of Colorado, made extensive use of these same structures to identify the stomach contents of small mammals.

Historically, the hairiness of plants has been described in terms representing the entire mass of hairs as it appears to the touch, or to the naked eye, or at low magnification—hence: minutely puberulent, pubescent, scabrous, hirsute, silky, woolly. These terms have been used inconsistently by many authors. There are many more precise terms to use when describing individual plant hairs (Fig. 4).

A cover or clothing hair is either unicellular, consisting of a single cell, or multicellular, made of more than one cell. The latter may be uniseriate having the cells in one series as in single file, or multiseriate being more than one cell wide. Terms describing overall shape such as tapering, tiered, conical, dendroid, stellate, tufted, hooked, forked, geniculate, falcate, peltate, sessile, or stalked may apply to either unicellular or multicellular hairs. Glandular hairs may have a secretion beneath the cell cuticle and look somewhat bubble-like. They may have a unicellular or a multicellular head with secretion-producing cells borne on a stalk of non-glandular cells; or the head of secretory cells may be sessile without a stalk.



a. Unicellular, dendroid hair of *Alyssum saxatile*
b. Multicellular, dendroid hair of *Lavendula officinalis*
c. Multicellular, uniseriate, tapering hair of *Gynura aurantiaca*
d. Conical, uniseriate hair of *Mentha*
e. Stalked, peltate, glandular hair of *Mentha*

Fig. 4. Descriptive terms for trichomes

Where can you find some interesting hairs to look at?

Mullein (*Verbascum thapsus* L.) has multicellular, uniseriate, tiered trichomes with hollow, dead cells.

Hollyhock (*Alcea rosea* L.) and many other members of the Malvaceae have variously simple, tapered, multicellular, uniseriate trichomes in addition to two- or more-forked or stalked, tufted trichomes with dead cells. Look also at *Malva neglecta* Wallr., cheeseweed. You may also see the rusty spots of the fungus *Puccinia malvacearum* Pers, or look at *Sphaeralcea coccinea* (Pursh) Rydb., the copper mallow.

Russian-Olive (*Eleagnus angustifolia* L.) has short-stalked, many-rayed trichomes. Many of these have the rays (30-60 or so) flattened and spreading at right angles to the stalk. These rays are often more or less fused to make a peltate scale (attached in the center at the back). These overlapping scales can cover the whole surface of the leaf, petiole, young stem, bud, fruit to give a silvery sheen, completely covering the green underneath. The Russian-Olive will also have some trichomes with the rays tufted and spreading in all directions from the point of attachment away from the leaf. In some related plants, as in the buffaloberry (*Shepherdia canadensis* (L.) Nutt.), at least some of the scales on the underside of the leaf will be a rusty-brown. The surface is often described as scurfy.

Mints (*Labiatae*). Many members of the mint family have interesting living trichomes. Two commonly encountered ones are the typical mint gland and an antler-shaped dendroid hair. The typical mint gland may arise in a depression in the leaf surface with a very short stalk and a flat peltate surface. On the top side an oily, and usually aromatic substance is secreted and held beneath the cuticle. This cuticle is easily broken when a leaf is handled to release the characteristic mint odor. The dendroid, forked, antler-shaped hairs superficially resemble the similarly-shaped ones in the mustard family, but here the trichomes are of several cells and the cells are living.

Velvet Plant (*Gynura aurantiaca* (Blume) DC). The leaf surface of this striking cultivated house plant of the sunflower family, *Compositae*, is covered with living hairs which have a reddish-colored sugar compound, an anthocyanin, within. The trichomes are multicellular, uniseriate, tapering with 5-6 cells.

Temple Bells (*Smithiantha cinnabarina* (Linden) Kuntze) in the African violet family has colored trichomes very much like those of *Gynura aurantiaca* but differing by having a dead terminal cell that is pointed and filled in with opalescent silicates.

One can also observe a great variety of trichomes on fruits and seeds.

Seeds: Milkweed, cotton, *Epilobium* spp.

Fruits: mountain mahogany, pink plumes, clematis and many others.

When you see a hairy plant, take a look, with a hand lens if possible, and compare the way it looks with how it feels. ■

Many hairy plants may be seen at Denver Botanic Gardens. The Alpine House will feature a special group of such plants this autumn. The Touching Place on the Conservatory balcony also displays plants with hairy textures.

References:

Carlquist, Sherwin. 1961. *Comparative Plant Anatomy.* New York: Holt, Rinehart & Winston.

Cowan, J. N. 1950. *The Rhododendron Leaf.* London: Oxford & Boyd.

Dunn, David B. 1969. (Personal communication) University of Missouri, Columbia.

Goodspeed, Th. H. 1954. The Genus Nicotiana. *Chronica Botanica* 16.

Hardin, James W. 1976. Terminology and Classification of *Quercus* Trichomes, *The Journal of the Mitchell Society* 92:151-161.

Rollins, Reed C. & Elizabeth A. Shaw. 1973. *The Genus Lesquerella (Cruciferae) in North America.* Cambridge, Mass.: Harvard University Press.

Uphof, J. C. Th. 1962. Plant Hairs, *Handbuch der Pflanzenanatomie.* Berlin-Nikolassee: Gerbruder Borntraeger.

Willard, W. Payne. 1978. A Glossary of Plant Hair Terminology. *Brittonia* 30(2):239-255.

Dahlia Storage

Susan Praetz

Late summer and early fall reveal the dahlia in its glory. When other summer plants are showing signs of season's end, the dahlia is presenting us with continued color and delight. Its only enemy, it seems, is the impending appearance of Jack Frost, who could arrive at any moment.

Susan Praetz, Gardener-Florist at Denver Botanic Gardens and a recent graduate of Regis College, is in charge of the Garden's dahlia collection.

After a killing frost the dahlia foliage should be cut down to about 6 inches above the ground and the plants labeled. As the ground provides an excellent natural, but temporary, storage place, the digging of the tuberous roots does not need to be done immediately.

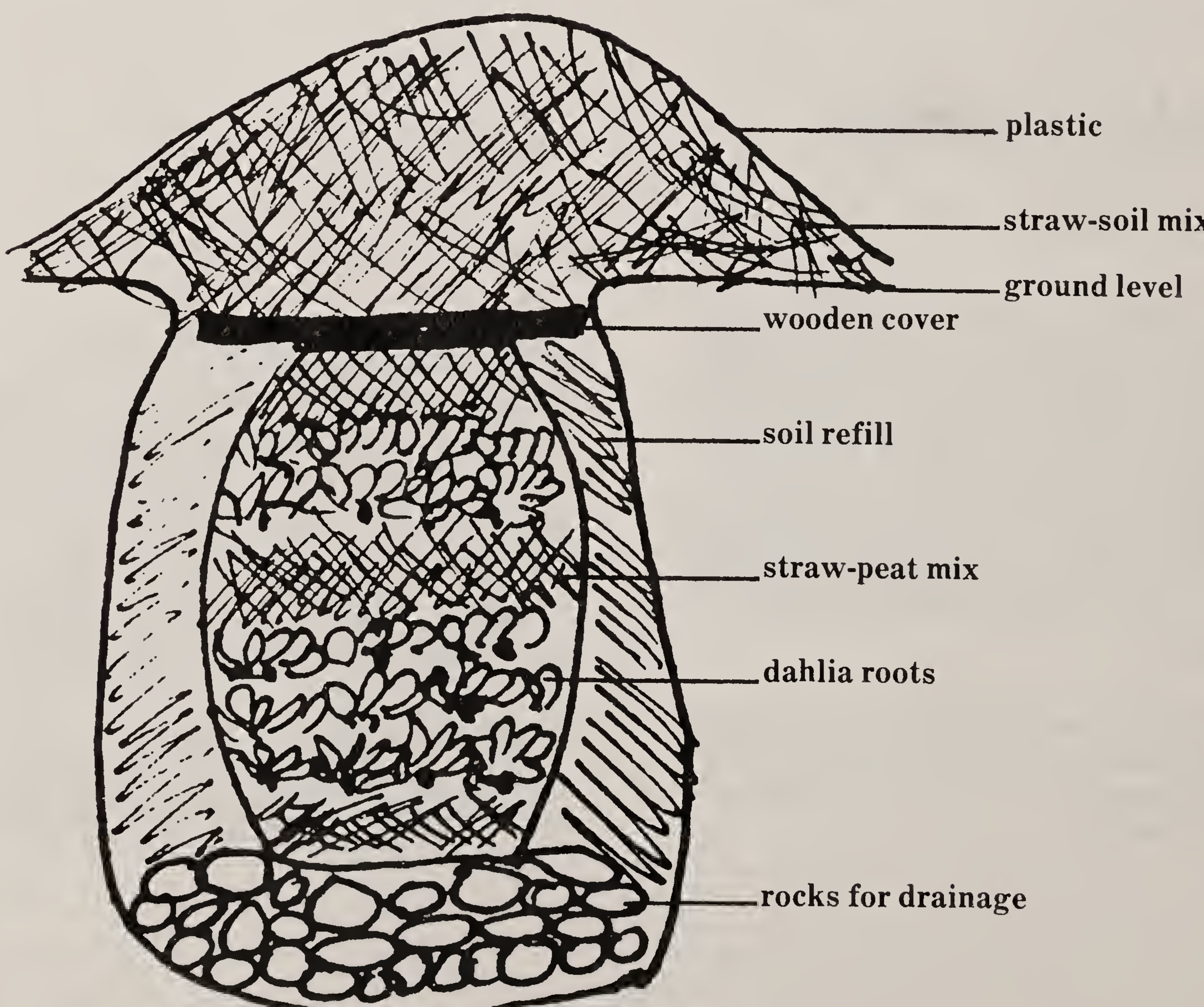
With the killing of the tops, one needs to consider what to do with the intensive network of tuberous

roots still very much alive underground, but which will not endure the freezing temperatures that penetrate the soil later in the season. The methods for care and storage of Denver Botanic Gardens' collection of over 350 plants is on a much larger scale than most home growers need, but the concept is easily adapted.

Roots are placed in redwood containers, packed loosely in a straw and peatmoss mixture, and the containers imbedded in a hole in the ground. We use redwood bins that had been storage places for hoses before we had sprinkler systems on the grounds. The bins are 2½ feet deep and 3 feet in diameter with holes in the bottom for drainage and aeration. A pit 5 feet deep, 5 feet wide and 15 feet long to accommodate four or five bins was dug. Railroad ties were placed in the bottom to keep the containers off the ground, should water accumulate. After the tubs of dahlia roots are placed side by side in the hole, soil is loosely replaced around the sides to the top, and the openings covered with plywood.

On a lesser scale the dahlia grower can dig a much smaller hole in the backyard and perhaps obtain a whiskey barrel or other wooden container for storage of a limited number of roots. The same procedure described can be followed with special emphasis placed on depth level for proper storage temperature (35°-50°F), moisture levels, use of a fungicide such as sulphur, and storing the roots upside down. This ground storage idea uses the same principles as the conventional root cellar.

With the storage place ready you can dig the roots at any time after the tops are frozen but before the



Dahlia storage in the back yard

Single root after division

soil freezes. A spading fork is best for digging. Stay a foot or so away from the main stem and go all the way around in a circle, lifting slightly as you go. Take your time and be careful to avoid damage to the clumps. Eventually the plant will be loosened and can be easily lifted. The final stem need be only 6 inches or less in length. Leave the soil around the tuberous roots, turn upside down with stems inverted and allow to dry for several hours. It is important to again stress the need for labeling. There are labels available through plant catalogues, or you can write directly on the roots with indelible ink. Frank Mansfield, an experienced dahlia grower and Denver Botanic Gardens volunteer, cuts old bleach bottles into strips, writes on them with indelible ink, punches holes in one end and attaches them to the roots with string. These labels are durable and can be used over and over.

The tuberous roots should be inspected for damage before storing. Broken ones should be removed and the whole clump should be dusted with sulphur. A layer of straw is placed in the bottom of the storage barrel with several layers of dahlias, followed by more straw. Peat moss can be slightly moistened and mixed with the straw, and sulphur can be dusted between layers, also, to control unwanted fungus growth. The last dahlia should be no closer than one foot from ground level, with a final layer of straw and a wooden cover over the opening.

Clump of tuberous dahlia roots

With a loose soil and straw mixture, cover the hole mounding to slightly above ground level. Place a piece of heavy plastic over the pit and secure it with bricks or rocks. The plastic, which will keep an over-accumulation of moisture from settling in the storage area, need be left on only when there is imminent danger of heavy snow.

The roots should be inspected for proper moisture levels during the winter—in late January or early February. If everything goes well, most of the dahlia roots will look the same as the day they were removed from the ground. Some have a tendency to shrivel, but they usually still have viable eyes.

The dahlia roots are removed from storage in April for a May planting. The clumps are then divided into individual roots, washed, placed in plastic bags with moistened peat moss, and moved to a warmer place to encourage sprouting.

The storage of dahlia roots can be done successfully from year to year, if one follows methods similar to the ones described. The bins, which may be used for other crops as well, can provide an end to the problem of deciding at the close of the growing season where to store the dahlias.

Dahlias are to be enjoyed, and having a permanent root storage facility allows for enjoyment of the same dahlias from year to year without costly replacement. ■

Exotics of Colorado

Bradford Pear, *Pyrus calleryana* 'Bradford'

Helen Marsh Zeiner

This year visitors to Denver Botanic Gardens the first week in April were treated to a breath-taking display of white bloom on the Bradford pear trees, *Pyrus calleryana* Decne. cultivar 'Bradford.' Always an early bloomer, the Bradford pear was especially early this year and fortunately escaped frost damage. Some years the buds are frozen before they have a chance to open. When they do bloom, they are lovely.

Most of us think of pears as trees grown for their delicious fruit, but Bradford pear is strictly an ornamental valued primarily for its beautiful display of spring bloom and the brilliant autumn color of its foliage.

Pears, members of the genus *Pyrus* of the rose family, can be divided into two groups: the occidental or Eurasian pears, to which the common pear and its many varieties belong; and the oriental or Chino-Japanese pears grown mainly for ornament. *Pyrus calleryana* 'Bradford' belongs to the Chino-Japanese group.

Pyrus calleryana Decne., the Callery pear, is native to China. It was named for J. M. M. Callery, a Roman Catholic missionary and collector from England who lived from 1810 to 1862. The genus name *Pyrus*, from the classical Latin *Pirus*, is an ancient Latin name for pear trees. *Pyrus calleryana* was introduced into the United States in 1908. Over the years several horticultural varieties or cultivars have been developed from *Pyrus calleryana*. These include Bradford, Aristocrat, Chanticleer, and Whitehouse. They differ mostly in growth habit of the tree. Bradford pear has an upright habit of growth. It is usually 25-35 feet tall, although it can grow to a height of 40 feet. It is narrowly conical as a young tree, becoming broadly oval with maturity. Aristocrat has a more horizontal branching habit than Bradford; Chanticleer is broader and cone-shaped; Whitehouse is a smaller, column-shaped tree.

Helen Marsh Zeiner, Ph.D., Curator of the Kathryn Kalmbach Herbarium writes "Exotics of Colorado" as a regular feature of *The Green Thumb.*

Bradford pear presents an interesting winter silhouette because of its upright branching habit. When you examine the leafless tree closely, you will find pubescent buds borne on glabrous branchlets.

The white flowers, each on a pedicel roughly an inch long, are about an inch or slightly less across. Each flower has 20 stamens and two or rarely three styles. In favorable years the flowers are produced profusely and blanket the tree with bloom.

The leaves, borne on petioles an inch and a half long, develop after the flowers. They are broad-ovate to ovate, with short acuminate (taper-pointed) tips and mostly rounded at the base. The edges are crenate (with rounded teeth, scalloped). The leaves are glabrous and very shiny, making handsome foliage all summer. In autumn they turn a lovely dark red, although occasionally frost or snow comes before they have reached their maximum color. The tree tends to hold its leaves late into the fall. This, together with the stiffly upright branching habit, makes the Bradford pear subject to breakage if there is an early heavy snow.

The fruits of Bradford pear are globular, about the size of a pea, slender-stalked, brown and dotted. They are seldom formed in Denver.

Bradford pear is not particular as to soil and appears to be resistant to fireblight. Its size is an advantage for many locations.

On the debit side we must consider the very early flowering time which can result in frozen buds and no flowers and the possibility of broken branches with an early fall snow.

Before you plant a Bradford pear you should seriously weigh the advantages against the disadvantages and then make your decision as to whether or not you want to try this tree. ■

References

Bailey, L. H. 1943. *The Standard Cyclopedia of Horticulture.* New York: The Macmillan Company.

Perkins, Harold O. 1965. *Ornamental Trees for Home Grounds.* New York: E. P. Dutton & Co., Inc.

Rehder, Alfred. 1940. *Manual of Cultivated Trees and Shrubs.* New York: The Macmillan Company.

A Guide to the Common Wildflower Families of Colorado

Janet L. Wingate

The study of wildflowers is a popular and rewarding hobby. "Which plant is that?" is often asked or wondered about. One aid in the identification of wildflowers is
90 the ability to place them into their proper plant family. This knowledge provides a "head start" in the identification of the wildflower.

Thirty common wildflower families found in Colorado were selected and divided into 7 groups according to basic floral structure. A few key characteristics are given for each family within the group. Most families can be recognized by these few characteristics once the basic floral structure is known. Representative genera with common names are listed for each family. Some families are included in more than one of the groups because of their varying characteristics.

To use this guide one must know the parts of the flower (fig. 1) and some general characteristics of the floral structure. The ovary is superior when the stamens, petals,

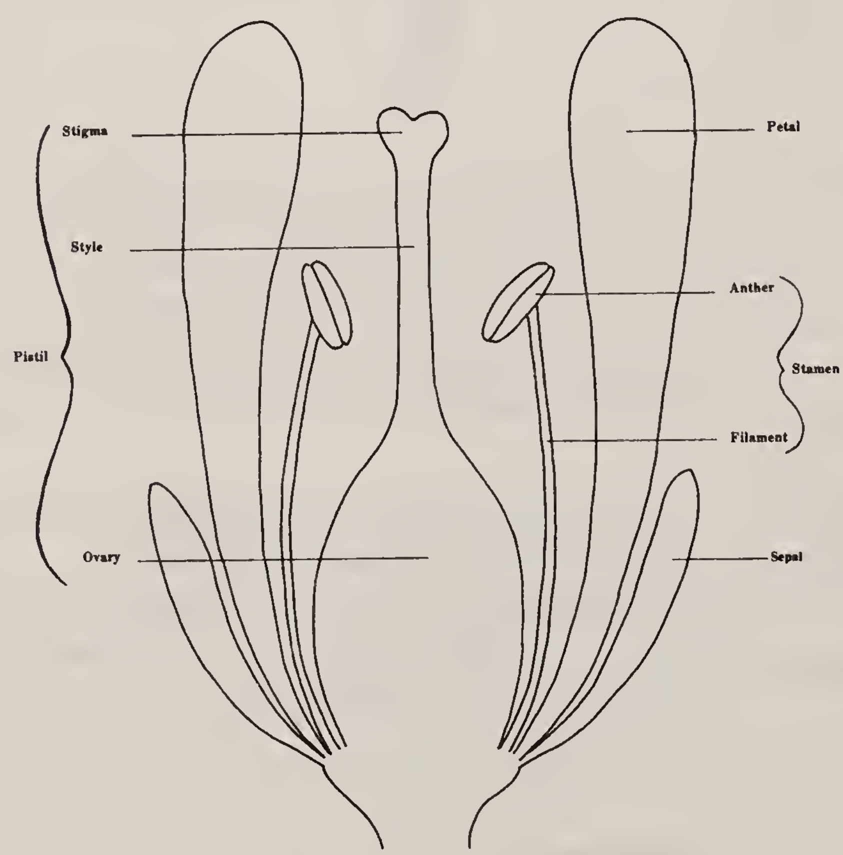


Fig. 1 Flower Parts

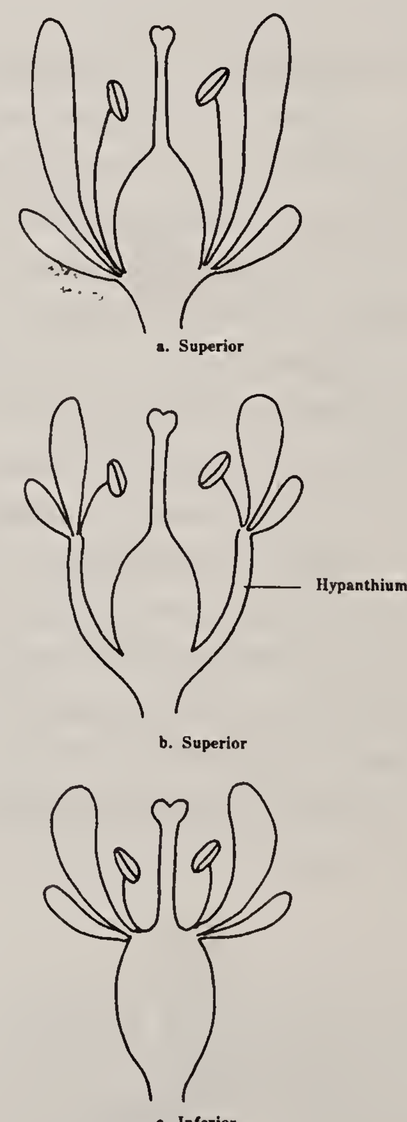


Fig. 2 Ovary Position

Janet L. Wingate, Ph.D., a staff member of Denver Botanic Gardens, works in the Kathryn Kalmbach Herbarium.

This article is reprinted from *The Green Thumb,* Summer, 1982, pp. 46-49, with corrections made in the position of the illustrations on pp. 48 and 49.

and sepals are attached at the base of the ovary (fig. 2a) or when they are attached to a hypanthium which is not fused to the ovary (fig. 2b). If the stamens, petals, and sepals are attached to the top of the ovary, the ovary is inferior (fig. 2c). Flowers are regular or irregular. A regular flower is radially symmetrical (Harebell) while an irregular flower is bilaterally symmetrical (Penstemon). These and other terms used in this article can be found in the glossary of any flora or botany text.

Unless otherwise stated the following plant families are usually herbaceous with 5 sepals, 5 petals, 5 or 10 stamens, and 1 pistil.

PETALS SEPARATE, OVARY SUPERIOR, FLOWER REGULAR

BERBERIDACEAE (Barberry Family) Flower parts in multiples of 3; stamens 6 and opposite the petals; flowers yellow; plants woody with holly-like leaves. *Mahonia* (Grape Holly)

CAPPARIDACEAE (Caper Family) Sepals 4; petals 4; stamens 6 to many and extending beyond the petals; leaves palmately compound. *Cleome* (Rocky Mountain Bee Plant)

CARYOPHYLLACEAE (Pink Family) Nodes swollen; leaves opposite; stamens usually 10; ovary 1-celled. *Cerastium* (Mouse Ear)

COMMELINACEAE (Spiderwort Family) Sepals 3 and green; petals 3 and often blue; veins of leaves parallel; stamens 6 with hairy filaments; leaf bases sheathing. *Tradescantia* (Spiderwort)

CRASSULACEAE (Stonecrop Family) Pistils 4 to 5 and separate or united at base; plants succulent. *Sedum* (Stonecrop)

CRUCIFERAE (Mustard Family) Sepals 4; petals 4; stamens 6 (2 short, 4 long); fruit with partition in middle which remains after the seeds fall; inflorescence a raceme. *Erysimum* (Wallflower)

ERICACEAE (Heath Family) Plants often with a somewhat scapose habit; stamens 10; anthers opening by terminal pores; fruit a many-seeded capsule. *Pyrola* (Wintergreen)

GERANIACEAE (Geranium Family) Fruit long beaked and splits up from base at maturity; leaves palmately lobed or pinnately compound. *Geranium*

LILIACEAE (Lily Family) Sepals 3 and resemble petals; petals 3; stamens 6; veins of leaves parallel. *Calochortus* (Mariposa or Sego Lily)

MALVACEAE (Mallow Family) Stamens numerous with fused filaments; hairs starlike (stellate). *Sphaeralcea* (Cowboys Delight)

PAPAVERACEAE (Poppy Family) Petals 4 to 6 and crumpled in bud; sepals 2 to 3 and falling as flower opens; stamens numerous; flowers showy. *Argemone* (Prickly Poppy)

POLYGONACEAE (Buckwheat Family) Flower parts often in multiples of 3; stipules sheathing when present; nodes often swollen; plants sometimes woody at base. *Eriogonum* (Sulfur Flower)

PORTULACACEAE (Purslane Family) Sepals usually 2; stamens opposite petals; plants succulent. *Claytonia* (Spring Beauty)

RANUNCULACEAE (Buttercup Family) Stamens numerous; pistils 3 to numerous (rarely 1); plants usually herbaceous but may be climbing and woody. *Ranunculus* (Buttercup)

ROSACEAE (Rose Family) Herbaceous or woody plants with numerous stamens (sometimes 5); hypanthium; pistils 1 to many. *Potentilla* (Cinquefoil)

SAXIFRAGACEAE (Saxifrage Family) Pistil often 2-horned; hypanthium; leaves often basal. *Saxifraga* (Saxifrage)

PETALS SEPARATE, OVARY SUPERIOR, FLOWER IRREGULAR

RANUNCULACEAE (Buttercup Family) Stamens numerous; pistils 3 to 5 (rarely 1). *Delphinium* (Larkspur), *Aconitum* (Monkshood)

FUMARIACEAE (Fumitory Family) Sepals 2 and tiny; petals 4 with one outer petal spurred; 2 inner petals united at top; stamens 6 and united in threes; leaves compound. *Corydalis* (Golden Smoke)

LEGUMINOSAE (Pea Family) "Pea" type flower (keel, 2 wings, and a banner); leaves compound; fruit a legume (bean-like); mostly herbaceous plants. *Thermopsis* (Golden Banner)

VIOLACEAE (Violet Family) "Violet" type flower; 1 petal spurred; 1 flower per flower stalk; ovary 3-celled. *Viola* (Violet)

PETALS SEPARATE, OVARY INFERIOR, FLOWER REGULAR

CACTACEAE (Cactus Family) Succulent plants with spines; flowers showy with numerous stamens. *Opuntia* (Prickly Pear)

IRIDACEAE (Iris Family) "Iris" type flower; leaves folded in half lengthwise; sepals 3 and resemble petals; styles 3 and resemble petals; petals 3, stamens 3. *Iris*

ROSACEAE (Rose Family) Trees or shrubs with numerous stamens (sometimes 5); fruit apple-like (pome). *Crataegus* (Hawthorn)

GROSSULARIACEAE (Gooseberry Family) Shrubs; hypanthium (short or long); leaves lobed; sepals resemble petals; fruit a berry. *Ribes* (Gooseberry, Currant)

LOASACEAE (Loasa Family) Leaves with hooked hairs (leaf will stick to clothing); stamens numerous. *Mentzelia* (Evening-star)

ONAGRACEAE (Evening-primrose Family) Sepals 4; petals 4; stamens 8. *Oenothera* (Evening Primrose)

SAXIFRAGACEAE (Saxifrage Family) Ovary usually partially inferior; pistil often 2-horned; leaves often basal. *Saxifraga* (Saxifrage)

UMBELLIFERAE (Parsley Family) Inflorescence an umbel; flowers small; stems commonly hollow; leaves usually compound; leaf bases sheathing. *Lomatium* (Salt-and-pepper)

PETALS FUSED, OVARY SUPERIOR, FLOWER REGULAR

ASCLEPIADACEAE (Milkweed Family) Flowers with hooded appendages between petals and stamens; ovaries 2, style and stigma 1; sap milky; leaves opposite or whorled. *Asclepias* (Milkweed)

BORAGINACEAE (Borage Family) Ovary 4-lobed and developing into 4 nutlets; folds or appendages common in the throat of corolla; plants often with stiff, bristle-like hairs (hispid) and often with a coiled inflorescence. *Cryptantha, Mertensia* (Chiming Bells)

ERICACEAE (Heath Family) Usually low woody plants with evergreen leaves, anthers opening by terminal pores or longitudinal slits, flowers often urn-shaped. *Arctostaphylos* (Kinnikinnik)

GENTIANACEAE (Gentian Family) Sessile leaves which are opposite or whorled; leaves and stems not hairy (glabrous); ovary 1-celled, stigma usually 2-lobed. *Gentiana* (Gentian)

HYDROPHYLLACEAE (Waterleaf Family) Stamens protruding beyond petals; inflorescence often coiled. *Hydrophyllum* (Waterleaf), *Phacelia* (Purple Fringe)

POLEMONIACEAE (Phlox Family) Stigma 3-branched; ovary 3-celled; plants may be woody at base. *Phlox, Ipomopsis* (Trumpet Gilia)

PRIMULACEAE (Primrose Family) Stamens opposite petals. *Primula* (Primrose), *Dodecatheon* (Shooting Star)

PETALS FUSED, OVARY SUPERIOR, FLOWER IRREGULAR

LABIATAE (Mint Family) Ovary 4-lobed and developing into 4 nutlets; stems square; leaves simple and opposite; stamens 4. *Mentha* (Mint)

SCROPHULARIACEAE (Figwort Family) Stamens usually 4, often a sterile 5th stamen is present; ovary 2-celled and developing into a capsule; leaves commonly opposite. *Penstemon*

PETALS FUSED, OVARY INFERIOR, FLOWER REGULAR

CAMPANULACEAE (Bellflower Family) Bell-shaped flower; fruit a many seeded capsule. *Campanula* (Harebell)

CAPRIFOLIACEAE (Honeysuckle Family) Shrubs with opposite leaves. *Lonicera* (Honeysuckle)

COMPOSITAE (Sunflower Family) Flowers grouped tightly together and surrounded by bracts (inflorescence a head); plants herbaceous or woody. *Aster*

ERICACEAE (Heath Family) Low woody plants; anthers opening by terminal pores; fruit a berry. *Vaccinium* (Blueberry, Huckleberry)

RUBIACEAE (Madder Family) Sepals 4; petals 4; leaves opposite or appearing whorled due to large leaf-like stipules; stems square. *Galium* (Bedstraw)

VALERIANACEAE (Valerian Family) Stamens 3; leaves opposite. *Valeriana* (Valerian)

PETALS FUSED, OVARY INFERIOR, FLOWER IRREGULAR

CAMPANULACEAE (Bellflower Family) Inflorescence a raceme; fruit a many seeded capsule. *Lobelia*

COMPOSITAE (Sunflower Family) Flowers grouped tightly together and surrounded by bracts (inflorescence a head); plants herbaceous or woody. *Agoseris* (False Dandelion)

VALERIANACEAE (Valerian Family) Stamens 3; leaves opposite. *Valeriana* (Valerian)

Useful References

Harrington, H. D. 1954. *Manual of the Plants of Colorado.* Chicago: Swallow Press, Inc.

________________ 1957. *How to Identify Plants.* Denver: Sage Books.

Nelson, Ruth Ashton. 1979. *Handbook of Rocky Mountain Plants.* Estes Park, CO: Skyland Publishers.

Porter, C. L. 1967. *Taxonomy of Flowering Plants.* San Francisco: W. H. Freeman and Company.

Great Gardens In Ireland—II

POWERSCOURT—An Italianate Garden in An Irish Setting

William G. Gambill, Jr.

In County Wicklow, only a few miles south of Dublin, near the village of Enniskerry, a truly grand Georgian mansion was finally completed in 1770 after being in construction for forty years. It was located on a plateau high above the River Dargle in a setting in the soft green Wicklow Hills that is considered one of the more picturesque in all of Ireland. Here on the Demesne (Estate) of the Powerscourt Family, in 1843, the 6th Viscount Powerscourt began dreaming of a garden which would do justice to its magnificent natural surroundings and would be a fitting complement to the imposing mansion. But it was the 7th Viscount in the line who saw the garden to completion over thirty years later. That they were eminently successful may be seen in the fact that 140 years after its beginning, Powerscourt is recognized as one of the great gardens of Europe—"an oasis of natural beauty, where, against a background of a thousand years of history, man has created a fairytale in flowers, trees and shrubberies, in stone, ironwork, bronze and water" (Powerscourt Tourist Office, 1973).

William G. Gambill, Jr., PhD., Director Emeritus of Denver Botanic Gardens, visited Ireland with a study group from the Massachusetts Horticultural Society in May, 1981.

How has this all come about? What are the features of this garden which have won it such high praise? Above all, how did a garden described as "Italianate" happen to be created in Ireland?

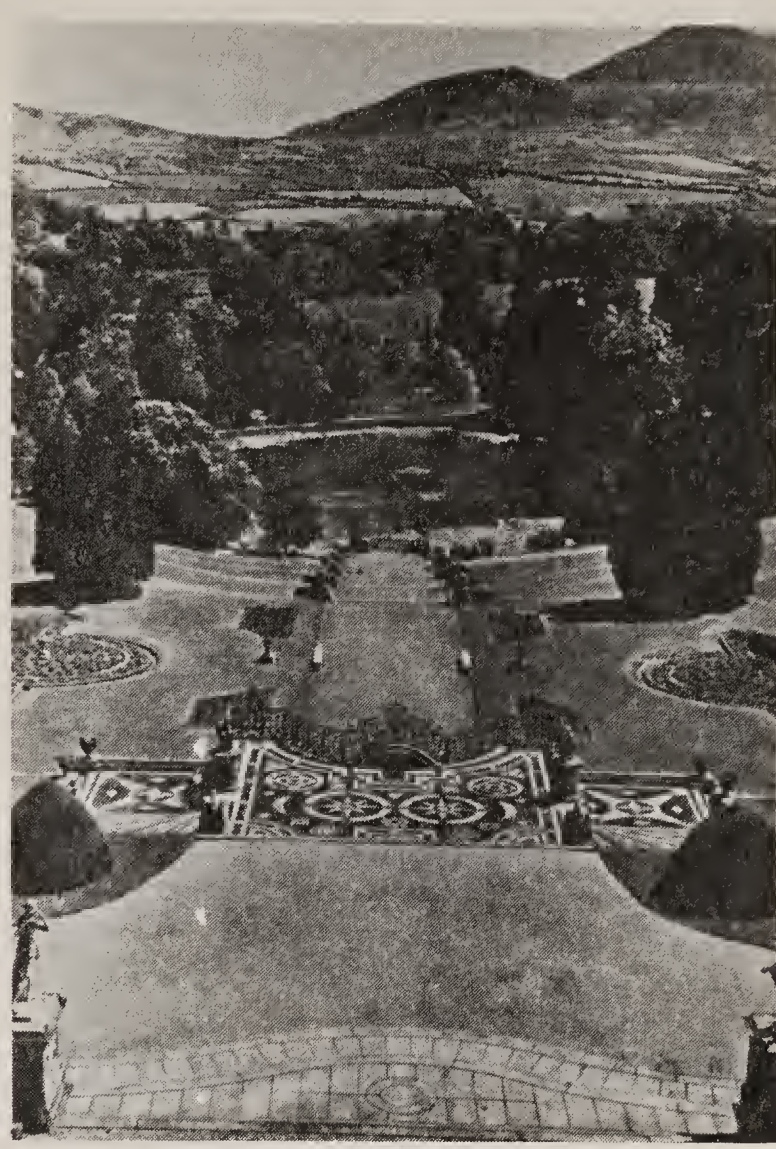
Knowledge of a little of the storybook history of Powerscourt would help an American visitor better to comprehend what he is seeing there. Ancient deeds show that the Estate was originally Church land. In the reign of Edward I (1239-1307) the site was occupied by a Royal Castle held by a Norman knight, Eustace de la Poer, from whom the family name Powerscourt was in time derived. A powerful Irish clan of Wicklow, the O'Tooles, later took the castle by storm; and still later it was held by the English Talbots. Sir Richard Wingfield in 1609 received the Estate under a grant from James I (1603-1625) who made him a Viscount and later named him Knight Marshall of Ireland. The Wingfields were Saxons who had been established in Sussex well before the Norman Conquest (1066), and Sir Richard became the ancestor of the Powerscourt Family.

The 9th Viscount Powerscourt sold the estate in 1961 to Mr. and Mrs. Ralph C. G. Slazenger who brought about many improvements before the great house was extensively

damaged by fire in 1974. Unhappily, when viewed from the garden the house appears today as a charred shell. But the garden remains in all its grandeur and the grounds of the estate were being maintained meticulously, at the time of this visit in 1981.

Entrance to the Powerscourt Estate is through the Eagle Gate and along a dramatic avenue of huge beech trees, many of which are more than 200 years old. Adding to the drama of the moment was a strong uncertainty about the ability of a wide, 35-passenger tour coach of 1980 vintage to negotiate the narrow gates designed long ago for smaller conveyances. This anxiety was soon forgotten as the incomparable view across the Estate toward the Wicklow Hills and Sugar Loaf Mountain unfolded. In a few minutes one was walking out onto the enormous terrace fronting the south facade of the mansion, from which the view of the Italian-inspired formal garden is quite literally breath-taking.

In design, the formal garden of Powerscourt resembles a vast, gently-curving amphitheatre set into the side of the hill, sloping down rather sharply by magnificent landscaped terraces to a lake, the Triton Pool, in the valley at its base. A 100-foot jet of water rises dramatically from a fountain-statue of Triton in the center of the pool. From there one's gaze moves farther to meadows, hedge-enclosed fields and up the blue-green slopes of the Wicklow Hills in the distance where the vista is dominated by the intriguing outline of Sugar Loaf Mountain against the sky. To confront this spectacle of the works of man and of nature in such a harmonious relationship is to reduce one to awed silence, followed by unbelieving admiration.



The terrace, Triton Pool with its twin Pegasi, and the profile of Sugar Loaf mountain.

Was there ever a more nearly perfect setting for a garden than this, and has any garden ever accommodated its setting as well as this one does?

Concerning this site, Edward Malins and Patrick Bowe made the following comments: "The whole perfect site is an example of the advice given on garden construction by Leon Battista Alberti, the Italian Renaissance author and architect: 'Familiar mountains' should be seen 'beyond the delicacy of gardens.' Here at Powerscourt this delicacy is achieved by a rare unity between man's planting of trees, shrubs and flowers, and the use of sculpture and water in a formal terraced garden—the one leading into the other, so that art and nature are joined, as in many of the great Italian gardens" (Malins & Bowe, 1980:82).

Pebble paved floor of the perron at Powerscourt.

A handsome, double staircase forty feet wide descends to the first terrace which is wide and spacious with beautiful lawns, flowerbeds, trees and shrubs and statuary. Six additional terraces lie below, each being semi-circular in shape, curving outward to the right and to the left from the central staircase. The terraces are not contained rigidly within walls, but grade off at the sides into informally planted woodland. They are beautifully shaped; the velvet green lawn of each slopes gently down to the terrace below it, the last one ending just above the Triton Pool. Each terrace has its own unique plantings, fountains and statuary.

A very noteworthy feature of the upper terrace is a central platform or perron with descending approaches to the second terrace. An intricately designed balustrade in black and gold wrought-iron marks the outer edge of the perron. At each end of the balustrade there is placed a group of figures in bronze, the *Amorini*, designed by the 18th century French sculptor, Joseph Marin. The floor of the perron and the surfaces of the steps leading from it are cobbled with black and white stones from the beach at nearby Bray, laid in intricate designs.

On the lower facade of the perron there is a carved alcove or grotto containing a handsome fountain. Above the fountain a sundial "for telling the sunny hours" is affixed to the stone wall, and on a pediment above the sundial is the sculptured head of Appollo as the sun-god, similar to that at the top of the Powerscourt coat-of-arms. On either side and above the fountain-basin, on pediments are statues of Eolus, the Roman God of Winds from which spouts of water also enter the fountain. These statues have an interesting history, having originated in the seventeenth century in the palace garden of the Duke of Litta at Lainate in North Italy. Through marriage they were acquired by Prince Jerome Napoleon, the nephew of Napoleon III, who took them to the garden of the Palais Royal in Paris. After the fall of the Second Empire, the prince sold them to Lord Powerscourt. The wrought-iron railings used on the perron had been rescued by Lord Powerscourt from a palace courtyard in Homberg in Hesse, lying disused and broken when they had been replaced by more modern ones (Malins & Bowe: 1980: 82,84,87).

At the foot of the staircase, but above the Triton Pool, there are placed two striking Pegasi, or winged horses. These were commissioned by Lord Powerscourt from the German sculptor, Hagen, in 1866, and are painted to look like bronze though they were cast in zinc. They have a special place of honor in the garden since they are

copied from the Powerscourt coat-of-arms. Malins and Bowe point out that "they are correctly placed near the pool, as Pegasus is symbolically the Steed of the Water, whose wings connote the wind of the freedom of imagination. When seen from the top of the perron, terminating the long vista with their shadows reflected in the water, they are well in scale with the Triton fountain in the center" (1980:88-89).

The Triton Pool is the focal point of this formal garden and it is beautifully framed in tree plantings so that the view, both within and beyond the gardens is quite open, but yet defined. Edward Hyams says: "whoever was responsible for the tree planting beyond the formal garden and the Pool. . . had the skill and knowledge to draw the distant view right into the garden by the manner in which the trees were chosen and planted. The technique of bringing a distant countryside into the garden was first developed by the great landscape gardeners of China." In this method, trees are carefully selected and placed according to the texture, density and color of their foliage, so as to create proper perspectives. This Chinese technique was described in English publications around 1790, and it is very probable that Lord Powerscourt or his architect was well acquainted with it. (Hyams & MacQuitty, 1967:92.) Around the Pool, tree plantings of deciduous and evergreen trees include redwoods from California, and the tallest tree in Ireland, a Sitka spruce (*Picea sitchensis* Carr.) from western North America.

It has been seen that the site of the Powerscourt garden, perhaps accidentally, fulfilled the specifications of one of the greatest Italian Renaissance landscape architects. But there is more. Richard, the 6th Viscount of Powerscourt, retained Daniel Robertson, a talented Irish architect of the period who had designed great houses and grounds for other Irish noblemen, to design the garden he and his predecessors had dreamed of for Powerscourt. Robertson drew up many plans for terraces, gardens and stonework between 1841 and 1843. The original plan was based on the steeply terraced gardens at the Sicilian Villa Butera (now the Villa Trabia) in Bagheria, according to Robertson, and was therefore essentially Italian in origin. Since neither Robertson nor Lord Powerscourt ever visited Sicily, how did Daniel Robertson know about this garden? This could possibly have been through the 2nd Marquess of Ormonde, a close friend of Lord Powerscourt, who had spent some months in Sicily in 1830 (Malins & Bowe, 1980:85).

Construction of the terraces began in 1843, but proceeded only with great difficulties, not the least of which was Daniel Robertson. Lord Powerscourt described him as a brilliant but dissolute man whose behavior became the source of many stories. At the time he was designing the garden he was deeply in debt, and on numerous occasions escaped from the Sheriff's officers by hiding under the roof in the domes of the great house. He was much given to drink, and because of severe gout had to be transported about the grounds in a wheelbarrow to do his work while clutching his daily bottle of sherry. As long as the sherry lasted he was brilliant in his designing and in directing the workmen. When the sherry was finished he collapsed, and could not work again until he had recovered from the effects (Malins & Bowe, 1980:84).

The 6th Viscount Powerscourt died suddenly in 1844, on his way home from a trip to Italy. Since Daniel Robertson had died in the meantime, also, work on the garden and terraces was suspended for nearly fourteen years. In 1847, Ireland was in the throes of the Great Famine, often referred to as the "Potato Famine." Records show that Lord Powerscourt at that time gave orders that most of the deer on the estate should be shot to provide food for the workers and their families. New drives through the Deer Park were constructed at this time as famine relief schemes and became a permanent part of the informal garden plan.

Work on the formal garden was resumed in 1858 when the 7th Viscount Powerscourt had reached the age of 21. Working with him was his brilliant Scottish gardener, Alexander Robertson, but no relative of Daniel, whose plans were finally being implemented. About 100 men with carts and horses moved great amounts of soil for the terraces by means of an inclined plane from the great house to Juggy's Pond, as the predecessor of the Triton Pool was rather ingloriously known at that time. More difficulties arose when ground water seeped out of the hill to the surface of the new terraces. After considerable delay Robertson solved the problem. Though he died suddenly of a stroke in 1860, work continued on the construction of the terraces. (Malins & Bowe, 1980: 85-86).

There is a walled garden at Powerscourt which was in existence long before the great formal garden was started in the 1840's. It is entered by a celebrated gate of wrought iron at the western end of the walk at the far end of the upper terrace. This gate, painted in gold and black is considered the finest in the gardens and came originally from the Bamberg cathedral in Germany, although it was purchased in London. It has a delightful *'trompe-l'oeil'* (eye-deceiving) perspective design carried out in scroll-work topped by a graceful vase of wrought-iron flowers, and dates from the 18th century. Another gate in this garden is known as the English Gate, and is of lacy, delicate iron-work between urn-capped piers. Leading to the kitchen garden is a double gate known as the Venetian Gate which was made for Lord Powerscourt in Venice at the beginning of the 19th century. On the east side of the walled garden is a

The Pegasi, Triton Fountain and Pool with Sitka spruce and Sugar Loaf Mountain in the background.

copy of an old German gate called the Chorus Gate, made by a London firm. The detailed work of this gate is similar to 17th century gates in Goerlitz, Germany. Four glass-houses, dating from 1859, are kept in excellent repair and are used today (Malins & Bowe, 1980:90).

At the south end of the walled garden there will be found what Hyams calls "a second piece of water-gardening, a formal circular basin called the Green Pond; it is here that one finds the great specimen of *Euonymus fimbriatus* Wall. (=*Euonymus indicus* Heyne) and, going beyond that arrives at a fine stretch of open park, turf-planted with well-grown specimen trees, the fall of the land being, as everywhere at Powerscourt, itself one of the pleasures of the eye" (1967:97). This area has been variously known as the American Garden, or the Pleasure-grounds. The Green Pond itself contains a fine collection of water lilies amid which is a beautifully sculptured dolphin fountain from which streams of water arise. At the end of the Green Pond is an unusually large specimen of *Eucalyptus globulus* Labill., Tasmanian blue gum. Other fine trees here include *Cupressus arizonica* Greene, Arizona cypress; *Juniperus cedrus* Webb & Berth., a rare juniper from the Canary Islands; *Picea likiangensis* (Franch.) Britz., a striking spruce from western China; *Abies cephalonica* Link, Greek fir; *Abies nordmanniana* Spach, Caucasian fir; *Nothofagus betuloides* Blume, an evergreen beech from New Zealand; *Nothofagus dombeyi* Blume, also a southern hemisphere beech; and *Cupressus macrocarpa* Hartw., Monterey cypress.

Within the Powerscourt Estate, and about two miles from the house, the River Dargle tumbles 398 feet in a sheer ribbon of water over black rocky cliffs to form the highest waterfall in Ireland and the British Isles. This is a spectacular sight which many visitors to the formal garden fail to see because it is out of sight and they must walk there. But perhaps more intriguing to a horticulturist are the tree plantings in the valley along which one walks to the waterfall. A grove of monkey puzzle trees (*Araucaria imbricata* Pav.) of enormous size is a spectacular sight. Of much interest to an American visitor is a fine planting of noble fir (*Abies procera* Rehd.) in the same area. Other trees in this valley are *Pseudotsuga menziesii* (Mirb.) Franco, Douglas-fir; *Sequoia sempervirens* Endl., the redwood; *Sequoiadendron giganteum* Bucholtz, California big-tree; *Cedrus atlantica* Manetti, Atlas cedar; *Thuja plicata* Donn., giant arbor-vitae.

The extent of the planting carried out by Lord Powerscourt cannot be appreciated until one reads the figures: 400,000 trees annually for ten years (1870-1880) in the 700-acre Ballyreagh Plantations. Among those planted were larch, Scots pine, Monterey pine, Corsican pine, redwoods, sequoias, araucarias, Lawson cypress, Sitka spruce and eucalyptus. Planting on this scale to some extent counteracted the wholesale denudation of the countryside by working-tenants, when they became new landowners after the Land Act (1903). Of great interest to foresters, at a time when forestry received scant attention from the public, was Lord Powerscourt's use of promising species of newer conifers (Malins & Bowe, 1980:93).

The statuary and other art objects are an integral part of the garden areas at Powerscourt, even as they

are in similar gardens in Italy. Interestingly, all the statues on the upper terrace are marble, while those on the second are in bronze. There is a wide variety of other art objects—fountains, basins, busts, seats, vases and urns, and even two old Roman sarcophagi rescued from a monastery garden near the Colosseum in Rome where they were being used for a drinking trough for stock and storage of chicken feed. These art objects are originals or copies in marble, concrete, granite, bronze and zinc, and in style range from ancient through baroque and neoclassical to modern. If there is a critical complaint about Powerscourt, it involves these decorative items which some visitors feel are over-abundant, even if individually they are in good taste (Malins & Bowe, 1980:87-94).

Edward Hyams, keen observer, chronicler and analyst of great gardens of the world, points out in his treatment of Powerscourt in his book, *Irish Gardens,* that the great Irish garden is often characterized as a "plantsman's paradise and the garden architect's despair." He goes on to say that "There is a point of view, and a perfectly valid one, that the plant material used in making a garden is of only secondary importance and that what matters is design and layout." He notes the great gardens of the Italian Renaissance and those of Japan, both highly regarded as examples of great garden art, and both with almost a paucity of plant material, in substantiation of his statement (1967:91). Powerscourt, among Irish gardens, demonstrates a great emphasis on formal shape and style; these have gained for it its greatest recognition. And yet, it certainly cannot be said that at Powerscourt beautiful and exciting plants are absent. They simply take second place to architectural design. Nonetheless, a visit to the formal garden at Powerscourt is a richly rewarding experience, as many have found. Other Irish gardens may be horticultural treasurehouses, but they may lack superb artistic design as seen at Powerscourt.

There is no better comment than that of Peter Coats to help place this great garden in perspective for the visitor of the latter part of the 20th century: "Powerscourt is a magnificent example of an aristocratic garden laid out with taste, knowledge and imagination. . . . It is extraordinary, too, in that it is probably the last garden of its size and quality ever to have been created. When it was completed in the 1870's, change was already in the air: garden design was soon to pass from the hands of the architects and artist into the hands of the horticulturist: green fingers are more adept with a trowel or pruning knife than with the set-square, and what had been the pastime of kings and noblemen was soon to become a hobby for the amateur horticulturist" (Coats, 1968:208). ■

References

Coats, Peter. 1968. *Great Gardens of the Western World.* London: The Hamlyn Publishing Group, Ltd.

Hyams, Edward & William MacQuitty. 1967. *Irish Gardens.* New York: The Macmillan Company.

Malins, Edward & the Knight of Glin. 1977. *Irish Gardens. The Irish Heritage Series: 11.* Dublin: Eason & Sons, Ltd.

__________ & Patrick Bowe. 1980. *Irish Gardens and Desmesnes from 1830.* New York: Rizzoli International Publications, Inc.

Nelson, E. G. & A. Brady, Ed. 1979. *Irish Gardening and Horticulture.* Dublin: Royal Horticultural Society of Ireland.

Powerscourt Tourist Office. 1973. *Powerscourt.* Powerscourt Estate: Enniskerry, Co. Wicklow, Ireland.

Denver Botanic Gardens, Inc.
A Non-Profit Organization

Officers

Staff

Illustration Sources

Front cover, pages 70,71: Drawings by Frances Frakes Hansen
Page 66: Photograph by Avalonne Kosanke
Pages 67-69: Drawings by Polly Steele
Page 74,75: Photographs courtesy of Kim Sorvig
Pages 76: Photograph by Esther Witte
Pages 77,78: Photographs by K. H. Shing
Pages 81,82,90-93: Drawings by Janet L. Wingate
Page 83: Drawings by Miriam L. Denham
Pages 86,87: Drawings by Susan Praetz
Pages 88,89: Drawings by Doris Peacock
Pages 95,96: Photographs reproduced by permission of George Weidenfeld & Nicolson, Ltd., London from Peter Coats, *Great Gardens of the Western World*.
Page 98: Photograph reproduced by permission of Powerscourt Travel Office, Enniskerry, County Wicklow, Ireland.

The Green Thumb
Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

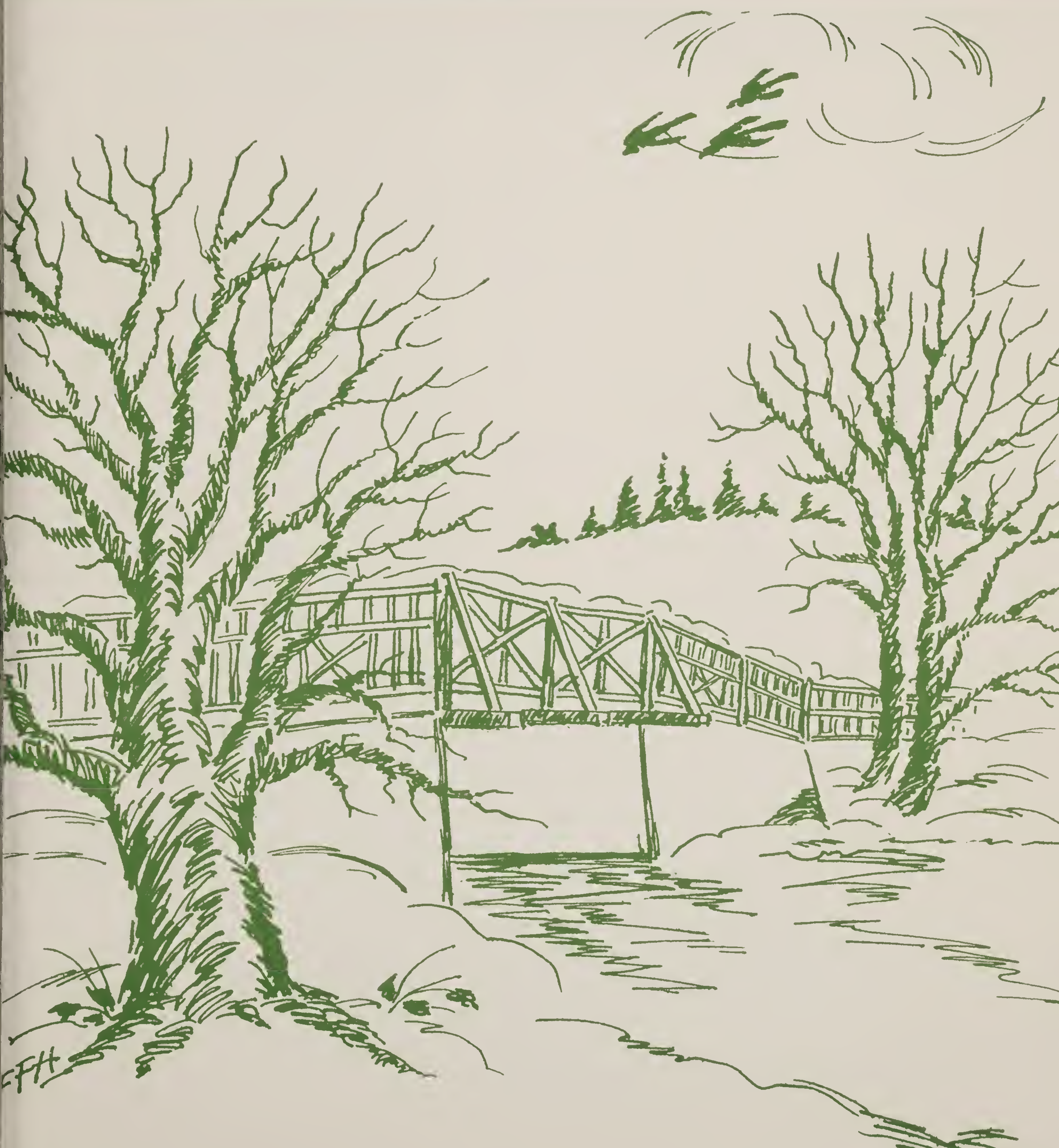
NON-PROFIT
ORG.
U. S. POSTAGE
PAID
Permit No. 205
Denver, Colorado

Do Not Fold

The Green Thumb

Winter 1982

Vol. Thirty-nine
Number Four



The Cover
Winter Beauty
Frances Frakes Hansen

The Green Thumb
Winter 1982
Vol. Thirty-nine, Number Four

Published by Denver Botanic Gardens, Inc., 909 York Street, Denver, Colorado 80206

Sent free to all members of the Denver Botanic Gardens. Membership fees are as follows: Classes of Membership— Individual Student $10.00, Individual Senior Citizen $10.00, Individual $15.00, Family $25.00, Contributing $50.00, Supporting $100.00, Corporate $200.00, Patron $500.00, Benefactor $1000.00.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thu* and the monthly *Newsletter*. You will also hav unlimited access to the use of the books in the Helen K. Fowler Library, located in Boettche Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens Hous 909 York Street, Denver, Colorado 80206, or call 575-3751.

The Green Thumb **Winter 1982**

Velma A. Richards
Editor

Contents

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

"The Idea Precedes the Accomplishment"

Is there anyone who does not agree that our Denver Botanic Gardens is one of Denver's most outstanding showplaces? But how many know we would not be so far along in our development of these gardens were it not for the pioneers who dreamed and planned for what we now enjoy?

Anna R. Garrey
1884-1982

Anna R. Garrey was one of those pioneers, and we might even say a "ringleader" of the small group of enthusiasts who started the action which finally evolved into what we now have. It was through her never-ending determination and constant prodding since the early 1900's that she and her fellow conspirators achieved their goal—the founding of Denver Botanic Gardens, Incorporated, with a firm agreement with the City of Denver to develop botanic gardens and arboreta. This agreement, covering many pages of details, made the corporation an agent of the City of Denver to develop the facilities and programs to educate the public in matters of botanical and horticultural interest.

It is not an exaggeration to say that Anna Garrey was largely responsible for the choice of charter trustees for this corporation, chartered in 1951. She was also influential in the selection of others of our loyal and diligent trustees, often knowing just the right person to nominate who would later serve as an officer. She was always constructive in her valuable and wise counsel when our many problems had to be solved, applying her guiding principle, "The

Idea Precedes the Accomplishment." Those who knew her well have been amused at many of her maneuvers, such as the time she personally went to Cheyenne to urge Dr. A. C. Hildreth to retire from his many years as Director of the U. S. Department of Agriculture's Experimental Station at Cheyenne, Wyoming and become Director of Denver Botanic Gardens. How could he say "No" to such a charming lady?

All too often people procrastinate in expressing their gratitude, but her friends and family showed their high esteem for her by dedicating the tetrahedral mound just southwest of the amphitheater as Anna's Overview, which carries the inscription written by her son, Reynolds Morse: "Service is the substance of human relationships—in appreciation of Anna Reynolds Morse Garrey, January 26, 1974."

The next time you visit the Gardens, walk up the steps, as she was able to do on her 90th birthday; notice how the entire garden stretches out before you; and reflect once more how much we owe to Anna R. Garrey.

MLS

Mrs. Garrey with Dr. A. C. Hildreth

Go Native, a plant seminar held last spring in Grand Junction, considered various aspects of landscaping in our semi-arid region. Although focusing on horticulture on Colorado's Western Slope, much information shared during the symposium was equally pertinent to other horticulturists, nurserymen and home gardeners who wish to plant and maintain attractive landscapes around our homes, businesses or institutions. Members of the Editorial Committee thought readers of *The Green Thumb* magazine might glean invaluable information from many of the presentations. Among those who spoke at the symposium were: Dorothy Falkenberg Borland, Gail Haggard, Curtis E. Swift, Harry Swift and Charles L. Weddle. Their articles which appear herein are based upon their talks presented at the seminar.

Go Native

Charles L. Weddle

A complete history of civilization could be constructed from a record of the plants man has cultivated. The importance of plants to man is biological. We needs plants for sustenance—for food and medicine for the body and for the very oxygen that we breathe. Plants are an ecological necessity for man—for shelter from the elements, for fuel and for their modifying effects on the climate of this planet on which we live.

Plants are a spiritual necessity. Created as spiritual beings, with deep inherent needs for beauty and order, we depend upon plants for our very concepts of serenity, peace and stability; yet plants stand out as proof positive of the creative force in the universe.

Charles L. Weddle, a horticulturist specializing in plant breeding, owns Weddle Native Gardens in Palisade, Colorado, where he offers many unusual native plants. Internationally recognized for his breeding of double petunias, he has received 24 All-America Selection Awards. Among them are 'Comanche,' 'Sugar Daddy,' and the 'Cascade' series petunias, 'Peter Pan' zinnia, and 'Rocket' snapdragon.

Civilizations that have survived have all been agricultural; cultures that have survived have been horticultural. Horticultural ability is the first manifestation of culture in any society. It is the foundation on which human culture or civilization is built.

So, in view of these well known facts, it is a travesty that so few people have more than a passing interest and a superficial knowledge of plants, the one class of organisms which provide food for both soul and body.

As the white man has moved about the globe, his first impact upon a new ecology is exploitative and often devastating. Either his animals graze and tramp out native flora, or he plows up the land, destroying the natural ecological balance for all time. A more recent manifestation of man's inhumanity to the earth I call "bulldozer blight." The hills are not everlasting any more. One man, with a bulldozer, can destroy more natural plant habitat in a day than nature

(in this dry climate of Colorado) can restore in a thousand years. Hence, even before science has had time to identify the plant life in the inter-mountain west, many species are in danger of extinction.

As civilization advanced westward, settlers brought with them the food, forage and ornamental plants with which they were familiar in more humid climates. But, even with plentiful irrigation water, many crops failed to adapt and were dropped or replaced. The search continues. Both public and private agencies are continually exploring for better adapted agronomic and food crops for dryland areas. Much progress has been made.

In ornamental horticulture, particularly in the nursery industry, progress has been less rapid. Since there has been relatively little local production, Colorado, New Mexico and Utah nurserymen and landscapers have been forced to import nursery stock from the east or west coasts and to accept varieties adapted primarily to those regions. These have been moisture loving species, sometimes of doubtful hardiness, unadapted to our climate and soil.

Recent events, however, have conspired to change these attitudes. Several years of low rainfall and a sudden population explosion have sharply focused public attention on the simple fact that water is no longer a freely expendable resource. Traditional, lush landscape is no longer affordable or, in many cases, possible.

Thomas Jefferson said one of the highest achievements of any man would be that he added another useful plant to the culture of the people. So, if you can gain knowledge of one new plant or add one new plant to your own individual culture, you will have achieved! I offer you some of my own favorite suggestions.

Before horticultural science has found a use for the native plants in any region, they are often no longer to be found. Sometimes exploitative use endangers a species before a method of cultivation is found. Such was the case with the tulip gentian (*Eustoma grandiflorum* (Raf.) Shinners) which, at the beginning of the century, was so abundant in central Texas. Florists didn't bother to cultivate it, since it grew so generously around the countryside. They picked it and used it for funeral flowers and home arrangements until, now, it is on the verge of extinction in its natural habitat. We have now learned to grow this handsome, long-stemmed, long-lasting beauty and it will be saved from that fate.

Tulip Gentian

A relatively new use for many types of native soil-binding plants is that of revegetation for reclamation of areas devastated by mining or other exploitative activities.

All wild plants are genetically variable. Many not now well suited for horticultural use could be

improved by selection. Many already useful could be made more so. For example, paper flower (*Psilostrophe bakerii* Greene) is normally a perennial that does not bloom the first year from seed. However, a few individuals do. By selecting those that do, we are close to breeding a strain that will uniformly bloom the first year.

The same is possible for false chamomile (*Matricaria inodora* L.) that we call crazy daisy, which is much more productive of flowers than the well known lemon scented herb. It doesn't have the fragrance, however, and we will cross the two strains of chamomile and select for the desirable characters of both.

Nature has already done the breeding work for us in the manzanita-kinnikinnik family. Three species of the genus grow on the Uncompaghre Plateau, together with obvious hybrids between the three, just waiting for some enterprising nurseryman to select and propagate them.

Thousands of Texas gardeners are at work selecting blue bonnets for freely germinating seed. The seeds that are hard simply don't germinate readily. Gardeners, even unconsciously, select plants which come quickly from the soft seed.

There is a great need in the west for plants tolerant to high salts in the soil. Research in California and Arizona has indicated that it is possible to breed plants for salt-tolerance, even in traditional field and vegetable crops such as alfalfa and tomatoes. Perhaps native species such as the salt bush (*Atriplex*) can be bred even more salt tolerant. Several salt bush species are excellent pot herbs.

The centers of population in the mountain west are at low altitudes. However, the plants provided by nurserymen are largely eastern species or high altitude natives. Many of these are difficult at low altitudes because of heat, chronically dry soil, salty soil, or a combination of the three.

Obviously, to be really useful, a plant must be adapted to the conditions in which it is to be grown. It is only logical to look to low altitude natives for plants with these adaptations. My interest in the low altitude species is partly because they have, heretofore, been largely neglected. Low altitude ranges have been even more abused than the mountains by over-grazing, chaining, clearing, and consequent erosion. Time is of the essence if we are to save many natives from extinction. ■

A Manzanita from the Uncompaghre Plateau

Living Within Our Water Means

Harry Swift

Living with limited water supplies has been the subject of writings and discussions among many people for ages. Indeed, so vital was the controversy over water in our history that many times it ended in killings.

The few million years before the white man started to live along the Front Range of the Rockies in Colorado only grasses and dry land shrubs existed right up to the foot of the mountains. The only exception was ponderosa pines growing along the Monument to Kiowa high ridge. There were not even trees along the stream beds where the first settlements were made. Immediately outside of the settled area, just a few feet away, was this wholly native vegetation growing as it does today adjacent to our outlying subdivisions.

Man has created an oasis in our High Plains semi-desert precisely as he has done all around the world for thousands of years. Today there are no traces, barely traces or only unearthed remains of many of those oases.

These man-made oases have been fragile and as they were established and expanded, and populations grew, they became ever more tenuous, and most of them evenutally disappeared. Although the reasons were many the principal one was water and its use. The survivors, able to "live within their (water) means," are marvelous, beautiful creations with the most salubrious living conditions. Man should attempt to prolong them in a livable condition as long as he can—the Colorado Front Range included.

Since a principal amenity of this oasis-living is our populations of plants for food and beauty, we must learn to use our water wisely, and still have beautiful, comfortable, functional plants for our homes. Presently we need not panic ourselves into thinking that our water use must be zero or our landscapes completely desert; we *can* make a comfortable environment with limited water and still consider needs of future generations.

Two reminders of our problem: from December 15, 1980 to May 15, 1981 our metropolitan precipitation was less than that of Phoenix, Arizona, situated in the well-known Sonoran desert; a few years ago at our nursery near Golden we had 7 inches of precipitation for the entire year—the norm for Phoenix, although Stapleton received more officially.

So, how do we preserve our horticultural oasis? The concept is not difficult: Use less water more wisely on plants which require little water but will still give us a lush, comfortable landscape. Sound like doubletalk? It isn't. Neither does it say we are limited to all native or desert plants, or a rock pile for our front yards.

About 27 years ago Harry Swift founded Western Evergreens, Golden, a nursery primarily devoted to propagating, experimenting, and distributing plants native to Colorado and the Southwest plus dozens of other plants that tolerate our High Plains, semi-desert environment.

The Pinon Pine—a drought-tolerant native

What will make the concept a reality?

- A thorough understanding about each plant's characteristics is essential.
- Water scarcity and high cost of water may lead to cultural shock—changing the way we perceive our relationship to our environment—away from the expansive greenbelts of our bluegrass lawns. Let's eliminate that concept of a perfect lawn which uses a very large percentage of all water consumed.
- Educate for wise water usage. Constant reminders, new water saving ideas, publicity about plant discoveries or new introductions should be conveyed by all those who have such knowledge—the "doers" and "movers" in our oasis, whether individuals, businesses or institutions. They must understand which plants to use where, planting procedures and techniques to fit each plant, and an ability to tell consumers how to maintain and water each plant.

Without this knowledge we will stumble into waterless oblivion; with this knowledge we can have a very desirable oasis.

A few examples of the hundreds of possible plants for our water conserving oasis:

Recently I saw a very large pfitzer juniper in heavy clay soil growing on a south facing slope in north

Arvada. Mostly dead Chinese elms were clustered where obviously a house once stood. Inquiry indicated the house had been abandoned for some 10 years but the pfitzer survived.

Many native pines can be observed on abandoned home sites on the plains surrounding Denver, thriving with no extra water.

The common lilac was a popular plant for windbreaks 50 years ago—not native but most durable.

On the steep south-facing cut slopes of the Valley Highway from Speer to University Boulevards the three-leaf sumac in August of the driest years is a very deep green with no extra water.

Curl-leaf mountain mahogany, Apache plume and cliffrose, all broadleaf evergreens, and many other plants can actually thrive with **no** supplemental water **after** they are properly established.

A very long list of plants, both native and from around the world, will thrive with only three to five supplemental waterings a year.

An important concept of water conservation in our horticultural plantings is rarely talked about or even known by gardeners, landscape architects or nurserymen. It involves a finely tuned feeling for each particular plant's needs: the soil type, the ground slope, direction of ground tilt, shadows from buildings, trees or fences, run-off from house or other buildings, undulations within general ground slope. No doubt a remarkable irrigation-free planting could be made with adequate consideration of plant selection and placement in accordance with these factors. For instance, if the yard was properly terraced and sloped, very little rain run-off from roofs need ever leave the property. Every yard has areas where it is 5, 10, or 15 times as wet, or dry, as in other areas.

A thorough understanding of these principles must be in the knowledge kit of gardeners, landscape architects and nurserymen who attempt to spread this information for an attractive, water-conserving oasis. ■

Curl-leaf Mountain Mahogany

Soil Preparation in Colorado's Grand Valley and Adjacent Areas

Curtis E. Swift

Soil preparation has to be one of the least understood facets of Colorado horticulture. Many gardeners, including some commercial horticulturists, completely neglect this area of gardening. This disregard for a plant's root environment many times results in problems later. In some areas of the nation, soil preparation consists of digging a hole and sticking in the plant. Not so in Colorado, especially in the Grand Valley and adjacent areas of Western Colorado where heavy clay soils and high salt levels are common. We are inundated with new ideas every year, with each idea felt to be the answer to our soil problem. However, many of these ideas make our problems worse.

The salt found in many areas of Western Colorado is commonly referred to as 'white alkali.' Some simply refer to it as alkali. These terms cause increased confusion due to their similarity with sodic soils which also are called 'alkali' soils. Gypsum may be used to help alleviate problems with sodic and so-called 'alkali' soils if the salts associated with them are earth carbonates, but when used on our 'alkali' soils, our problems increase. Earth carbonates are the carbonates of sodium (Na), magnesium (Mg), and calcium (Ca). Salts of importance in the Grand Valley and adjacent soils are sulfates.

Sodic or Saline

In order to help alleviate this confusion of terms many journal and research articles now use the terms 'sodic' and 'saline.' A sodic soil is one which has a salt complex of which 15% or more is sodium based. A saline soil is one with a salt problem with less than 15% being sodium. Our soils are 'saline' in nature.

Our saline soil conditions are due to an excess of calcium sulfate, more commonly known as gypsum. Many parts of Grand Junction have a soil called Billings silty clay loam. It contains an average of 16 tons of gypsum per acre foot of soil. Not all

---

Curtis E. Swift, Colorado Extension Horticulturist for the Tri-River area on the Western Slope since January 1980, organized the *Go Native* symposium held in Grand Junction last March. While working in the Extension Plant Disease Clinic at C.S.U., Fort Collins, he coordinated the Extension component of Colorado's federally funded Dutch Elm Disease project.

area gardeners have the Billings soil type. Some Western Colorado residents have to contend with very little gypsum; others with up to 70 tons of gypsum per acre.

Some sodic ('Black Alkali') soils do exist in Colorado, especially in the San Luis Valley. In these soils, gypsum has to be added to 'free' the sodium allowing it to be leached out of the soil. In the case of saline/sodic soils, there usually is sufficient naturally existing gypsum to correct the sodium problem—without adding additional gypsum. If gypsum is added, this decision should be based on a soil test report. Adding gypsum when not needed can result in solving the sodium problem, but can produce or increase the saline problem.

Drainage

In addition to gypsum, magnesium sulfate, carbonates and bicarbonates make up the rest of the major salts in our soil. Most of the salts can be washed out of the soil if the soil has good drainage. *If*—is the problem!

Our major soil type is, as mentioned previously, a silty clay loam. Even though the initial wetting of the soil may be quite rapid, movement of water through this type of soil is very slow (0.06 to 0.2 inches/hr.). At this rate it would take from 60 to 200 hours for water applied to the soil surface to move down one foot. If water is applied more quickly, it simply runs off or puddles. Many area soils also have shale and other impermeable layers further compounding the problem. These soils have to be amended.

Soil Amendment

In order to reduce the salt level to allow many plants to be grown successfully and to facilitate development of an adequate root system, these soils need to be loosened. Gypsum is said to loosen clay soils; **not** ours! It increases our problems! How about sand? To reduce the salt level requires good soil drainage. Sand is said to loosen clay soils. Adding sand to our soils results in further compaction; in other words, concrete results! Sand **can** be used to loosen our clay soils, but should be coarse and make up at least ⅓ of the total soil volume; i.e., if a 6 inch depth of soil is to be amended with sand, then 3 inches of sand is needed.

The best amendment for our soil is organic matter. This includes compost, horse manure, peat moss and shredded leaves. These materials should be partially decomposed but at the same time fairly coarse. If too fine a material is used, it tends to block drainage instead of improving it. If too fresh, it tends to create a nitrogen deficiency. In the latter case, about 4 lbs. of urea or ammonium nitrate added per 1000 square feet of amended area would be beneficial. Three cubic yards of organic matter needs to be used per 1000 square feet area. This needs to be worked in as deep and as thoroughly as possible.

Leaching Out the Salts

After the soil is amended to improve drainage, salts can then be leached out of the soil. Obviously, good quality irrigation water low in dissolved salts, needs to be used. With few exceptions, wells in the Grand Valley area have to be disqualified because of excessive salt levels.

Once a low salt water is available, sufficient water needs to be applied to leach the salts from the soil. The following chart gives guidelines:

Water needed for salt reduction.

Amount of good quality water passing through a foot of soil will decrease the salt concentration by the approximate percentages listed below.

Amount of water	% Salt reduction
6 inches (15.2 centimeters)	50%
1 foot (30.5 cm)	80%
2 feet (60.9 cm)	90%

Salt levels are measured by electrical conductivity, stated as millimhos per centimeter (mmho/cm). The more electricity that passes through a solution, (the greater the number of mmhos/cm), the higher the salt level. A reading of 3-4 mmho/cm is the maximum tolerance of bluegrass, 2.5 is about maximum for garden beans, yet, it is not uncommon to have salt readings of 15 mmhos/cm or even higher in some Grand Valley soils.

More Problems

Why not apply something to neutralize the salts? Any suggestions? Some people recommend sulfur. Sulfur ties up with the calcium that is abundant in our soils. This results in producing more gypsum (calcium sulfate).

In some cases the salt level cannot be reduced because of poor internal drainage below the amended soil or the tremendous amount of water needed to leach the salts out of the soils. This is the time when knowing the salt tolerance of individual species of plants comes in handy. Planting non-tolerant plants can result in disasterous effects. In some areas, bluegrass, common trees such as spruce, linden and maple, as well as many shrubs, flowers and ground covers cannot be grown because of our combination of heavy clay soils and high salt levels.

Western soils are difficult. They generally are of a heavy silty clay loam consistency and have high levels of salts. Few areas of the state have this combination to the excess we do. Our 'problems' dictate a more thorough understanding of our soils and how they respond when treated with the 'common' corrective remedies. Many of these remedies don't work—they just increase problems.

The task of planting a tree, shrub, lawn or ground cover is not always as simple and easy as many gardening buffs and magazines would lead you to believe. This article has covered the amendment of Grand Valley soils. This does not mean that soil preparation is all that is necessary for success, even though it is of utmost importance. Confusion exists with the terms alkaline and alkali and a lack of understanding their meanings results in increased problems. The depth of planting trees and shrubs, and the shape of the planting hole, also are vital if success is to be realized.

In our soils a thorough understanding of plant needs, soil types and the interaction of these two factors must be taken into account for success. Neglecting proper soil preparation, proper plant selection, and proper planting technique results in the death of many plants each year on the Western Slope. ■

Dryland Turf for Colorado

Dorothy Falkenberg Borland

Interest in the use of drought tolerant or native plants to reduce water and maintenance needs of landscapes is increasing. Kentucky bluegrass (*Poa pratensis* L.), once the favorite turfgrass for the High Plains and Rocky Mountain West, is quickly losing favor. But, by discarding bluegrass, what grasses have we to work with? Several of the grass possibilities available to us in Colorado and the surrounding areas are considered.

Before selecting any grass, know your climate and soil. In the lower elevations of Colorado, our climatic regime can range from arid (less than 8 inches precipitation/year) to semiarid (8-15 inches precipitation/year). Regardless of the categorization, we live in a warm, dry area where water is at a premium. There are grasses that have adapted to different climatic conditions. Bermudagrass (*Cynondon dactylon* (L.) Pers.), buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.), and blue grama (*Bouteloua gracilis* (H.B.K.) Lag. *ex* Steudel) are quite tolerant of high temperatures and low precipitation patterns. The fine fescues (*Festuca rubra* L.) are better adapted to higher elevations with more precipitation and cooler temperatures. Many grasses will grow outside their natural adaptive range, but special care, such as irrigation, must be given.

Dorothy Falkenberg Borland did her Masters thesis on "Buffalograss, Blue Grama, and Fairway Wheatgrass for Dryland Turf". Currently, she is living in Grand Junction and working for High Country Lawns, a turf establishment and maintenance company.

Soils, although very seldom a limiting factor, should be considered more regularly than they are when choosing a species or variety of grass. Clay soils and sandy soils can and should be amended with organic matter before seeding a turf area. However, high salt soils (also called alkali soils) are not as easy to change. Depending on the severity and the type of salts present as identified by a professional soil test, sometimes the only recourse is to use highly salt tolerant grasses although the turf quality will be different from that of other grasses. Bermudagrass and alkaligrass (*Puccinellia distans* (L.) Parl.) can tolerate very high salt levels (approximately 18 and 50 mmhos/cm, respectively) while bluegrass can tolerate only 4 mmhos/cm. The ability of a water sample to conduct electricity is used to determine its salt content. It is usually reported as millimhos per centimeter (mmhos/cm). Other options for high salt soils include use of salt tolerant shrubs, especially natives, or heaven forbid, growing decorative rock.

Kentucky bluegrass is a cool season, sod forming grass that is an old standby familiar to us. Under correct management, this grass exhibits good drought tolerance and remains green almost year round. Bluegrass will tolerate different levels of maintenance and provide an acceptable turf. There are many, many varieties of bluegrass available, each with different levels of resistance to shade, diseases, and drought. If bluegrass is used, it is

recommended to use a blend of several varieties of bluegrass or use a bluegrass/perennial ryegrass (*Lolium perenne* L.) mix with no more than 30% perennial ryegrass in the mix.

Buffalograss

Buffalograss seems to be the most popular 'dryland' grass to plant. It is a native warm season grass that forms a tight sod with stolons. It is a dioecious species, having separate male and female plants, with the burs and seeds found close to the ground on the female plant. The flag-like male flowers extend above the foliage providing a reddish cast when in bloom. Buffalograss browns with the first frost and 'greens up' 3-4 weeks after Kentucky bluegrass in the spring. When cool temperatures cause buffalograss to go dormant, no amount of care will green it up. This grass, once established, exhibits excellent drought and heat tolerance and good wear tolerance. Buffalograss has good recuperative powers.

This grass can create an attractive turf. It seldom grows over 6 inches in height so mowing is often optional. It will take a 1½ inch cut well; but under frequent mowing, turf quality may deteriorate. Irrigation after establishment will improve the appearance of the buffalograss turf. Although the actual water requirements of buffalograss have not been determined, adequate irrigation seems to be about 2-3 inches applied at one time, once a month, through the growing season. Buffalograss does respond rapidly to nitrogen fertilizer applied at 0.5 pounds/1000 square feet (Borland 1981).

The seeding rate of alternative grasses is often a lucky guess. At Colorado State University, studies were conducted using buffalograss at 5 seeding rates with no irrigation after scheduled establishment irrigation. Almost complete cover was achieved within 3-4 months after seeding using 4 lbs PLS/1000 square ft. (Pure Live Seed: % germination x % purity). If irrigation is planned and you are willing to wait for complete cover, a lower seeding rate of 2 lbs PLS/1000 square feet could be used (Borland 1981). Always use and specifically ask for **treated** seed. Its germination rate is approximately 70-80% compared to a 7-10% germination of freshly harvested or untreated seed (Archer, 1953; Ft. Hayes 1967). Several varieties of buffalograss are available on the market.

Another native dryland grass that makes an acceptable lawn grass is **blue grama.** It is a warm season bunchgrass that grows to 10-16 inches tall and may become clumpy

over time if heat or drought stressed. The reaction of blue grama to heat and drought stress is similar to that of buffalograss. It is found in association with buffalograss in nature and is sometimes thought to be better in a mix.

Blue grama can be mowed if desired to a height of 2-2½ inches. The seeding rate for this light seed is 1 lb/1000 square feet with establishment irrigation. Several varieties are available.

Blue Grama

Crested and **fairway wheatgrass** (*Agropyron desertorum J.A. Schultes* and *A. cristatum* (L.) Gaertn.) are often used in low maintenance turf areas. Crested wheatgrass is one of the most commonly used grasses for revegetation. It is a cool season bunchgrass and will produce a solid cover in a pure stand only when not water stressed.

Fairway wheat grass is the most promising turf-type wheatgrass. It also is a cool season bunchgrass; but with heavy seeding rates (over 3 lbs/1000 square feet) and intermittent irrigation, an acceptable turf will develop. Fairway wheatgrass has better mowing tolerance than crested wheatgrass and can be mowed at 2½-3 inches. It will brown under heat and drought stress, but will green up with irrigation or cooler weather.

Smooth bromegrass (*Bromus inermis* Leysser), is another grass that has potential as a turfgrass. A coarse textured sod former, it will remain green through periods of water stress. It will take a 3-4 inch mowing height and irrigation helps maintain its green color. There are many varieties available.

Tall fescue (*Festuca arundinaceae* Schreber), often considered a lawn weed, is a coarse textured, cool season bunchgrass. Varieties with a finer leaf texture are available. It is a vigorous grower, exhibits good heat, cold and drought tolerance and has relatively low fertilizer requirements. Tall fescue can tolerate a 2-2½ inch mowing height and has good tolerance to intensive traffic.

Grasses suited to the Rocky Mountain West with high salt tolerance include bermudagrass, alkaligrass, and perennial ryegrass. **Bermudagrass,** one of the principle turfgrasses of the South, is a very aggressive, warm season grass with excellent heat, drought, and salt tolerance. This grass forms a dense tough sod with both rhizomes and stolons. It may suffer from winterkill in most of Colorado due to cold, dry winters. Common varieties are more likely to survive in Colorado than newer improved varieties. The common varieties can be established by seed or by plugging from an existing stand with proven winter hardiness.

Alkaligrass is a relative newcomer to the world of turf. It is a cool season bunchgrass that will tolerate up to 20 mmhos/cm salt content in the soil. It reacts to mowing height and irrigation needs very much like bluegrass. Seeding rate should be 3-4 lbs/1000 square feet.

Many, if not all, of the grasses mentioned here plus others are being grown in test plots at the Gardens. Buffalograss lawns can be found in Denver, Aurora, Ft. Collins, and other cities as well. No *one* grass is the only grass for a particular site. Evaluate **your** area, **your** turf needs, and the capabilities of the various grasses before making a choice. Then, match management practices to the needs of the grass.

References

Archer, S.G. and C.E. Bunch. 1953. *The American Grass Book—A Manual of Pasture and Range Practices.* Univ. of Oklahoma Press: Norman, OK. 330pp.

Falkenberg, Dorothy A. 1981. *Buffalograss, Blue Grama, and Fairway Wheatgrass for Dryland Turf.* MS Thesis. Colo. St. Univ., Fort Collins, CO 189pp.

Fort Hays Experiment Station, 1967. *Suggestions for planting buffalograss seed.* Unnumbered leaflet, March 1967, Hays, KS. 2pp.

Art and Artists, *The Green Thumb*— Phil Hayward

The versatility of Phil Hayward's artistic talents has been an integral part of *The Green Thumb* magazine for more than 30 years.

Born in Milwaukee, he studied at the American Academy of Art in Chicago. Throughout his career he has been professional artist or art director at various agencies and corporations in this area. However, it is as a painter of character portraits, scenes of the West and contemporary ranch life that Phil derives his greatest satisfaction.

His first contributions to *The Green Thumb* magazine appeared in June 1950—a cover and illustrations for an article, "Scientific Tree Care." Over the years as a volunteer he has created lively cartoons to brighten the magazine; a montage was the magazine's silver anniversary cover; a distinctive typeface was the signature of Denver Botanic Gardens' publications for more than a decade; his botanically accurate tone drawings have illustrated countless articles in the "Focus On" series written by his wife, Peg. These articles describing plants of the conservatory, are the nucleus of the tour guide workbook. Together they have edited and designed the Conservatory Plant Guide through many printings.

The Olive—*Olea europa*

The Haywards travel throughout the Southwest where Phil gathers material for his detailed portraits of native American Indians. Their travels have also taken them to the Orient, the South Seas, Central America and most recently Kenya and the Seychelle Islands off the African Coast. Phil studies the colorful life and natives of these countries while Peg gains insight into "Tropical Plants of the Conservatory" which she eagerly shares in her tour guide classes at the Gardens as well as in her classes in Ikebana.

At his studio and gallery in southwest Denver Phil devotes most of his time developing his painting skills in watercolor and acrylic for his carefully detailed figures, landscapes and animals. His watercolor "Mountain Man" won the silver medal award at the Colorado Western Heritage Art Show. His paintings have been featured in *Western Horseman* and *Ford Times* magazines and may be seen in private and corporate collections. He exhibits in several select galleries in the Western United States. —BEP

FOCUS ON *Theobroma cacao* in the Boettcher Memorial Conservatory

Peg Hayward

Theobroma cacao L. is properly called 'food of the gods' from the Greek *theos*, god, and *broma,* food, in allusion to the products of the tree, chocolate and cocoa. *T. cacao* is one of about 30 species of the Sterculiaceae family. The genus consists of trees indigenous to tropical South and Central America.

Mention of "chocolatl" or the cacao tree from which it came was made frequently in the old stories about Cortez and his conquest of Mexico in 1519. "Chocolatl" was made from ground cocoa beans flavored with vanilla, honey, and spices and beaten until it was covered with foam. Chocolate was so important in the Aztec economy that its 'beans' were used as currency.

The cocoa tree is evergreen and grows to a height of 40 feet, but on plantations is usually kept pruned to between 15 and 20 feet. The tree has a wide, spreading head of simple, leathery leaves, each about a foot long which droop from downy twigs. Young leaves are particularly attractive for they are coppery red, pendulous and quite limp to begin with, but soon stiffen and become green. When the trees are 3 to 4 years old they begin to flower. Very small, delicate, star-shaped flowers are creamy or yellowish with pink calyxes. They grow in clusters from small cushions on the trunks and larger branches of the trees. It takes nearly 4 months for the blossoms to develop into fruits and of the many flowers only a few make fruit. It is estimated that only one in ever 500 flowers matures to a ripe fruit. The reason for this is that the flowers are ill adapted for pollination by regular methods or for self-pollination. It is believed the main pollinating agents are ceretopogonid midges. The curious foot-ball shaped fruits, commonly referred to as a pod, are longitudinally ribbed. They are 10 to 12 inches long and 4 inches in diameter, green at first turning reddish-brown later. Each pod contains 5 rows of about 10 bean-sized seeds embedded in a mucilaginous, whitish pulp. A good cocoa tree will bear from 60 to 70 fruits a year and since the trees bloom continuously blossoms and a few fruits will be hanging grotesquely from the trunk or large branches throughout the year.

Peg Hayward writes "Focus On" as a regular feature of *The Green Thumb.*

Theobroma cacao

To make cocoa or chocolate, the pods are opened and the seeds and pulp removed and left to ferment for a few days. During this process the beans gain their characteristic aroma. The seeds are then washed and dried and sent to the factories where they are roasted and the shells broken away. To produce the powdery cocoa the roasted kernels are ground up and put through a pressure machine that squeezes out some of the fat or cocoa butter. Chocolate results when most of the fat is retained. The cocoa butter is used as an important ingredient of pharmaceutical and cosmetic preparations.

The cocoa tree, although originating in the American tropics and strictly limited to the inner tropics, is now widely dispersed in this belt, the chief production being in West Africa.

A young *T. cacao* tree may be seen in the Boettcher Conservatory collection.

References

Brouk, B. 1975. *Plants Consumed by Man.* London: Academic Press Inc.

Everett, T.H. 1968. *Living Trees of the World.* New York: Doubleday and Company, Inc.

Hyams, Edward. 1971. *Plants in the Service of Man.* Philadelphia: J. B. Lippincott Company.

A Meadow of Natives

David Deardorff and Gail Haggard

120 In the Southwest we live under a broad sky in expanses of open terrain. Many of us want to landscape in harmony with this country.

Wild plants native to our region are the right plants to use. They are adapted to our climate, soils, and pests, and they don't need coddling. This saves time, work, money—and water.

We are all faced with a bewildering variety of demands on our time—only one of which is grooming plants in our yards and maintaining our property values. Lawns can be of native grasses, formal plantings can be accomplished with native shrubs and wildflowers, that single stately shade tree can be a native tree. Native plants are versatile, colorful, and attractive. And if it is a meadow you hope for—a meadow of mixed heights and textures with color all season long—you can create a meadow in your own yard using native grasses and wildflowers. Your yard may be 10 square feet, 1,000 square feet, or 10 square miles.

David Deardorff and Gail Haggard are associates at Plants of the Southwest, a company specializing in the introduction of native grasses, wildflowers, trees and shrubs, and of well-adapted vegetables. Their catalogue of over 200 offerings is available for $1.00: 1570 Pacheco St., Santa Fe, NM 87501.

Grasses

Native grasses are varied and intriguing. Buffalograss and blue grama grass are 4 inches and 12 inches high respectively at maturity. For this reason they make excellent native lawns. Galleta gives a tough durable cover because of its vigorous underground runners, and therefore makes an outstanding grass for erosion control. The native grasses are very decorative—and wonderful for dried arrangements. Little bluestem, a tall bunch grass, turns russet as it dries and is particularly lovely in the snow. Indian ricegrass, a medium height bunch grass, has lacy seed heads. The Western wheatgrasses have tall, straight, symmetrical seed heads.

Galleta

Wildflowers

These are very brief portraits, but we'll go on to the wildflowers so you can mix the grasses and wildflowers in your mind's eye and begin to see this meadow.

Wildflowers provide brilliant all-season color with different species blooming from earliest spring to the hard freezes of fall. In a small plot where you want solid color, or in children's gardens where you want instant action, annuals are a fine choice. You can have them up and flowering in six weeks, and many will reseed themselves.

White Evening Primrose

Perennials will usually not bloom the first year, but from the second year on, your efforts will be rewarded. Native penstemons of all different colors are available now—yellow, white, red, blue, and pink. Penstemons are among the aristocrats of our flora. The daisy or sunflower family has incredibly varied members. Nuttall's sunflower (*Helianthus nuttallii* T&B), is a beautiful, formal, late-blooming sunflower that can grow 8 feet tall. Other sunflowers demand belly botany, like the Easter daisy which blooms in very early spring—so small you have to crawl on your belly to see it! Gayfeather (*Liatris punctata* Hook), a very unusual composite, blooms in late fall with purple spikes. This 2-foot-tall plant has 15-foot-deep roots. You can see how it copes with dry years.

Rabbitbrush and purple aster blooming together *are* the character of much of the Southwest in the fall. The yellow and purple color combination of the fall is the first color combination of the spring as well, with Perky Sue (*Hymenoxys argentea* (A. Gray) Parker), and *Penstemon secundiflorus* Berth. For a color combination you might not think of, try fern verbena, pink evening primrose, and California poppy. These flowers bloom over the same long time period, and we have found them stunning massed together. They are purple, pink, and orange! White flowers are valued in part because white can wed any color to any other color. There are a number of white native evening primroses, blackfoot daisy is rugged and long blooming, and *Penstemon cobaea* Nutt. and ox-eye daisy are beautiful whites, too.

Don't forget that right around your house you have different climates. On the north and east sides you can use shade-loving, more water-needful, or higher-elevation plants. On the west and south sides you'd better stick to those sunloving, drought-tolerant species.

Rocky Mountain bee plant (*Cleome serrulata* Pursh, a Pueblo pot paint and sustainer in famine with its abundant seed), purple aster, verbena, and verbesina are good pioneers and advantage should be taken of this by using these in different spots. The beautiful red columbine and the Santa Fe phlox are most delicate and make good rock garden specimens.

Bird lovers and butterfly lovers—a meadow is for you. We are fortunate to have 15 different hummingbirds in the West, (the ruby-throated is the only hummingbird widespread in the East). They are easily attracted by

planting bright red flowers which they home in on from great distances (like most birds they have excellent color vision), but, once in your garden they will visit flowers of any color in search of nectar and small insects.

Hummingbird flowers have much in common. They are long and tubular, often borne sideways or drooping rather than upright, and contain abundant nectar. The hummingbirds hover before the flowers, insert their long bills and tongues for the nectar, all the while whirring their wings more than 3,000 times a minute.

Red Columbine

Good flower choices for hummingbirds also provide all-season-long color: red columbine (*Aquilegia elegantula* Greene) and Indian paintbrush (*Castilleja integra* Gray) bloom in the spring, scarlet bugler (*Penstemon barbatus* (Cav.) Roth and other penstemons) and skyrocket (*Ipomopsis aggregata* (Pursh) V. Grant) in the summer, hummingbird trumpet (*Zauschneria latifolia* Greene) in the fall. Some species, such as Indian paintbrush, scarlet hedgenettle (*Stachys coccinea* Jacq.) and *Salvia greggii* Gray, begin blooming in early spring and are stopped only by fall frosts.

Seed-eating birds will enjoy the seeds of the grasses and wildflowers in your meadow. Among the seed eaters are nuthatches, tit-mice, sparrows, finches, siskins, towhees, juncos, jays, Clark's nutcracker, and, of course, quail, pheasant and doves.

Butterflyweed (*Asclepias tuberosa* L.) truly attracts butterflies, and it is a spectacular orange. Its cousin, the common milkweed (*Asclepias speciosa* Tarr.) has silvery pink flowers and is the specific host plant of the regal Monarch butterfly. Other excellent butterfly plants of the West are indigobush (*Amorpha fruiticosa* L. and *A. canescens* Pursh), shrubby cinquefoil (*Pentaphylloides floribunda* (Pursh) A. Love) and the rudbeckias.

You can see some of the array of possibilities with a meadow. Here now is the how-to of putting that meadow—large or small—on your property. Most important is, don't get discouraged. For example, the wind would just as soon carry all your seed to the next county. And, one way or another, nature works full time at planting, and you cannot. We've outlined a good, rigorous way of going about it.

Shrubby Cinquefoil

Other methods, even quite idiosyncratic methods, will probably work if you follow through on them. Your own observations are very valuable—we would like to say essential—but it may take some time to feel confident about them.

Some people will enrich their existing meadow by scuffing wildflower seed between the grass clumps. Others will start from scratch. It takes the same amount of work to establish a meadow as it does a new lawn. The real payoff comes in maintenance—meadows take less work and water than lawns. Meadows are not easy to establish (nothing is!). But once they are established they are indestructible.

Timing:

- With summer rains and harsh windy dry springs, it is clearly better to sow in summer. Warm season grasses will not germinate until the soil is warm. Therefore, these should be sown during the summer months, June through August. If sown later they will not germinate until the following year.
- Cool season grasses are best sown in spring and fall.
- A mixture of cool and warm season grasses is best sown in the summer. Remember, the warm season grasses, such as blue grama, look their best in the summer and are beige fall through spring. This is different from Kentucky bluegrass which looks its greenest in fall and spring and is kept from going dormant in summer by pouring on the water.

Soil Preparation:

- Remove existing weeds or grass with repeated rototilling, digging, hand weeding, or if unavoidable, weedkiller.
- Improve soil with organic matter and fertilizer. Manures and composts help retain moisture, improve soil structure and provide some nutrients. Quality lawn fertilizer at 10 lbs. per 1000 sq. feet is appropriate.
- Rototill and allow the first flush of weeds to appear.
- Hoe or rototill to kill weed seedlings.
- Rake or roll level.

Seeding:

- "Dilute" seeds, which are often very small and easy to put on too small an area, with sand, coarse sawdust, or peat. Use 3-4 lbs. native grass seed per 1000 sq. feet and 2 oz. wildflower mix.
- Hand sow—choose a still day and sow with broad sweeps of your arm. It's helpful to sow first east to west, then north to south to get an even cover.
- Rake in seed ¼ inch deep.

Mulching:

- Mulch with rich earth, sawdust, hay or straw. Be sure those are weedfree. Or use cloth (old sheets, gunny sacks, plastic shade cloth) as a mulch.
- Use a binder, a sticky substance when wetted, if the area is on a slope or the weather is windy.
- Water through the mulch.
- Remove the cloth mulch a couple of days after the seedlings appear.

Watering:

- Water at least twice a day for the first 3 weeks, more often if it is hot and windy and the ground dries quickly.
- Water once a day for the subsequent 3 weeks.
- After the initial 6 weeks water deeply twice a week for a month, then once a week for another month.
- After the meadow or lawn has been established, only occasional waterings are needed in all but the driest years.

Mowing:

- Mowing a lawn will stimulate tillering (sprouting from the base) and help control weeds, but do not cut newly sown grasses until they are 4 inches high. When the grasses are established you can cut at the height you wish.
- A wildflower meadow should be mowed only after the growing season. If mowed before this the flowering stalks will be destroyed. Mowing in autumn cuts down any dried flowering stalks and makes the appearance tidy.

Weeding:

- Once established hand weeding will cope with occasional weeds.
- Mowing helps control weeds in a lawn.
- Don't use lawn weedkillers, which kill broadleaf weeds; on a meadow, the wildflowers will be killed as well.

Can you plant a meadow of native plants and walk away? Treat the meadow and its denizens with benign neglect? No, not really. It is true that a meadow, once established, and if planned with care initially, can be left without damage to dryland plants. But to look its best, weeding and watering must be done—perhaps twice a season. Gardens will always need gardeners. ■

May Bonfils Stanton Rose Garden

Joan Franson

Nearing the close of a warm summer afternoon, on August 31, 1982, the May Bonfils Stanton Rose Garden in Denver Botanic Gardens was dedicated. This event had long been anticipated, from the first plantings of roses at the City Park location to the roses blooming now in this beautiful setting.

A cooling breeze moved through the roses as Lawrence A. Long, former president of Denver Botanic Gardens, welcomed the Mayor, members of the Board of Trustees and guests. He introduced John C. Mitchell, the immediate past president of the Board, who gave a historical resume of roses at the Gardens.

Mr. Mitchell explained that in 1954 the first serious effort to develop a Rose Garden evolved through a $3000 gift from the Denver Rose Society for the preparation and some maintenance of a rose garden in the Botanic Gardens' location then in City Park just west of the Denver Museum of Natural History. In addition 3,600 roses were donated by the Denver Rose Society through the kindness of growers throughout the United States—"a fine tribute from the growers and to the fledgling Botanic Gardens."

In 1956 Mrs. Vella Conrad began serving as a volunteer rose consultant, performing a great service for the Gardens in that capacity until her death in 1964. In the late '50s the Botanic Gardens was moved from the unprotected open area near the Museum to its present site on York Street where adequate security is provided for the plantings.

In 1971 Charles Edwin Stanton, Chairman of the Bonfils-Stanton Foundation, contributed several pieces of white Carrara marble statuary to Denver Botanic Gardens in memory of Mrs. Stanton from their Belmar estate, and now in the Rose Garden here. Again in 1971 the Denver Rose Society gave an additional $1000 for the preparation of a site for a new rose garden in accordance with the Master Plan prepared by Eckbo, Dean, Austin and Williams. Other contributions toward a rose garden have been given in memory of Tochie and Hudson Moore, Sr. by their families, Mr. and Mrs. Hudson Moore, Jr., Mr. and Mrs. David W. Moore and Mrs. and Mrs. Willett S. Moore.

Mr. Mitchell continued by noting that through the efforts of Melvin G. Roberts, then President of the Colorado National Bank, $30,000 was given from the liquidation of the G. G. Leibhardt Trust to endow maintenance of the Rose Garden. Remembering the Leibhardts' interest in roses, with their estate called "Rose Acres," this seemed a most appropriate use of their trust funds.

Joan Franson, Rocky Mountain District Director of the American Rose Society for the past six years, is an accredited Rose Life Judge and a Consulting Rosarian. She and her husband, Herb, have been avid rosarians since coming to Denver in 1961. An Associate of Denver Botanic Gardens, she serves in many other volunteer capacities.

In 1981 the Bonfils-Stanton Foundation gave $125,000 for construction and development of the new rose garden. Associates of Denver Botanic Gardens contributed $25,000 that same year to the Rose Garden Endowment with the stipulation that the income be used for an internship in horticulture especially for this garden and the culture of roses.

Mr. Stanton, donor and benefactor of the Rose Garden, expressing his pleasure in sharing this occasion with those present, said, "It is a most important event in the plan of the Bonfils-Stanton Foundation, for this is the first significant gift that has been made from the Foundation since it was established. It is especially gratifying to me as it is a growing gift and will give pleasure to everyone who will visit this wonderful exhibit of beauty in flowers and plants."

Merle Moore, Director of Denver Botanic Gardens, indicated that, although we are dedicating "a *new* Rose Garden, roses are not *new* to Colorado. Dr. William Weber, Curator of the Herbarium at the University of Colorado, lists three species of roses in his *Rocky Mountain Flora.* The oldest known fossil record of a rose leaf was found in Colorado and was verified to have existed at least 40 million years ago. We can only imagine the extent of change that has occurred in the rose over 40 million years of both natural and man-influenced evolution. The Chinese are credited with bringing the rose under cultivation over 5000 years ago and they used extensive plantings of roses in great park-like areas. Today the variety of color, size, and form has made the rose the most well-known garden plant across the country—perhaps throughout the entire hemisphere."

In the May Bonfils Stanton Rose Garden can be found all the major types of roses—species, old garden and shrub, hybrid teas, floribundas and grandifloras, climbing roses, polyanthas and miniature roses. "Here in one garden," Mr. Moore continued, "are the resources needed to observe, study, select and care for those roses which have

Ribbon cutting at the Rose Garden

proven adaptable to our High Plains growing conditions. These resources are equally accessible to the casual visitor, the recent Denver resident looking for gardening ideas, the long time resident and the advanced gardener wanting to seek out newer and better plants, and the professional landscape architect, contractor or nurseryman, who look to the Botanic Gardens as the place where plants are introduced, tested and evaluated for their landscape potential."

In addition to the display garden are the two test gardens: the All-America Rose Selections Garden, one of 23 such gardens across the nation, established here in 1968 and now located east of the Japanese Garden; and the American Rose Society Miniature Rose Garden, one of five nationwide, established in 1980. From these two test gardens records are compiled that, after two years of testing, help determine the most outstanding roses for meritorious designation.

Mr. Moore recognized many whose efforts and sustained interest have led to establishing the Rose Garden. John and Nancy Mitchell were instrumental in getting the AARS Rose Test Garden located here. Colorado rose organizations, especially the Denver Rose Society, have played a vital role in the development of this garden. Joan Franson and Linda Brown serve as evaluators of the rose test gardens and advise on roses in general. Joan, Ross Lahr, Warren Kirkley and William Campbell, who make up the rose garden sub-committee, worked with the landscape architect in design detail and planting arrangements. Dr. Campbell, an avid grower of species and old garden roses, donated many of these roses to the garden.

Herb Schaal, principal landscape architect for EDAW, Inc. in Fort Collins, designed the Rose Garden with its graceful, laminated beams in the trellises. L & M Enterprises, Inc. of Berthoud, Colorado, did the actual construction guided by Larry Bebo, president of the firm. The marble urns and bench donated by Mr. Stanton were installed by Frank Swanson, talented Colorado sculptor.

Mr. Moore also praised the skilled horticultural staff who plant and care for this valuable collection of roses. Joann Narverud, gardener florist, is responsible for the daily care of the roses. Gayle Weinstein, botanist horticulturist, and Frank Chavarria, gardener foreman, work with Joann in developing design and maintenance programs for the garden.

With the encouragement and cooperation of Mr. Stanton and the financial support of the Bonfils-Stanton Foundation, whose board members include Mr. Stanton, Robert E. Stanton, Mrs. John F. Kelly, Louis J. Duman, Johnston Livingston, Benjamin Stapleton and Mrs. Don Schmidt this garden has become a reality. The contribution to the Rose Garden Endowment Fund from the Associates, along with a gift from Mr. and Mrs. J. Clark Coe have provided for the future maintenance of the garden as well as for an annual internship in applied horticulture for a college student majoring in botany or horticulture.

"When recognizing those persons who have made a commitment to Denver Botanic Gardens over the long term, who have been supportive of the Gardens' development, and who share the pride we all feel in this great Botanic Garden that

has been created here on the High Plains of Colorado," Mr. Moore stated, "one must include Mayor William McNichols. Without the support we receive from the City and County of Denver through Mayor McNichols, Joe Ciancio, Manager of Parks and Recreation, and numerous other city departments we call on for support and assistance, it would be impossible to be here today dedicating this magnificent May Bonfills Stanton Rose Garden. We are fortunate to have the Mayor's support, encouragement, and cooperation as we work together to develop and maintain one of this country's finest botanical and horticultural institutions."

Mayor McNichols spoke of his delight in being a part of the Rose Garden dedication and asked Mr. Stanton to share with him in the cutting of the ribbon to the garden, saying, "Once again it is a pleasure to take part in the activities of Denver Botanic Gardens, which is such an important part of our city—an oasis in a metropolitan area, a virtual Garden of Eden. On behalf of the City and County of Denver, it is my pleasure to accept the May Bonfils Stanton Rose Garden."

Mr. Long concluded by indulging in a bit of nostalgia, saying, "I used to live in that big old house just on the other side of the wall behind you. We all worked very hard to get this site for the Gardens, but at times I had mixed emotions. Every year I planted rows of corn and a few vegetables on this side of the wall. Well, you can guess what happened—we got the site but I lost my garden. Most especially missed were those rows of beautiful corn on the cob.

"And now let me finish by paraphrasing a well-known saying: 'A rose by any other name'—can always be found in the May Bonfils Stanton Rose Garden." ■

1983 Williamsburg Garden Symposium

Andrew Pierce

One of the more noted areas of all the eastern coast, much steeped in history—be it of plants or places—is Williamsburg, Virginia, the destination of Denver Botanic Gardens 1983 spring tour. Although visitors there step back in time historically, today Williamsburg, in liasion with the American Horticultural Society, offers one of the finest garden symposiums of America.

Williamsburg is 350 years old and like many early settlements it was just a cluster of houses situated between two rivers with an inn, two mills, a church and a smithy. When the statehouse of Jamestown was leveled by fire in 1698, the capital was moved to Middle Plantation, an early name for the area; and the town was renamed Williamsburg in honor of William III, the reigning English king. Celebration as a state capital lasted but 81 years when Richmond was then so honored. During this period Williamsburg was the cultural center and meeting place of the region. It was also a planters town for the Virginia tobacco growers who supplied their English ancestors' habit. Francis Nicholson, the governor at the turn of the century (1698-1705), promoted a grand capital where streets were wide, up to 90 feet, and the lots half an acre in size, so that it would be a "green country town."

Andrew Pierce, Assistant Director of Denver Botanic Gardens, serves on the tour committee and sometimes accompanies the tour groups as the botanist-horticulturist.

Today many of the gardens have been restored to their early grandeur and much of the fine old furniture graces the buildings that are on view to visitors.

The yearly garden symposium will be held April 17-21, 1983, a date somewhat later than normal, giving attendees the opportunity to see azaleas in their full glory. This will be the main feature plant at nearby Norfolk Botanical Gardens, which is included in the program. Flower arrangements at Williamsburg are always an eye catching feature in the historic buildings, but the symposium registrants will be able to compare them with floral displays done by an arranger from the White House in Washington, and a floral designer from Keukenhof, Holland, where floral beauty is not only in a container but in the ground by the acre.

People today always find individual situations where plants fail to grow or, at best, just survive. Emphasis will be made to help solve such problems with programs on "Gardens in Small Spaces," "Difficult Situations," "Use of Perennials" and "New Fields to Cultivate." At the same time workshops on pruning, brick laying and maintenence will be offered.

"Natural Plants in Williamsburg and its Woodlands" will present insights into the past; and visits to Carter's Grove plantation along

with the newly featured Bassett Hall (Williamsburg home of the late Mr. & Mrs. John D. Rockefeller, Jr.) should be enthralling.

Program presenters range from landscape architects to members of the Williamsburg horticultural staff, and include a former president of the American Orchid Society whose subject is "Orchids for the Common Man." Such is the prestige of the Williamsburg Symposium that we can assure you not only a delightful time but an incredible chance to gather information as well. Similar to many of our tours we are going to extend the time in the area and visit other private gardens and institutions with the opportunity to collect even more ideas. Our base for this period will be in nearby Richmond.

Williamsburg may well be the greatest exhibit on 100 acres in America. One can only begin to comprehend the historical magnitude or assimilate the beauty of Virginia's flora in a short visit. The Denver Botanic Gardens' spring tour offers the opportunity to sample the beauty and the historical significance of the region and at the same time gain valuable horticultural knowlege. ■

Historic Williamsburg

INDICES

SUBJECT INDEX 1982

(Spring pp. 1-32, Summer pp. 33-64, Autumn pp. 65-100, Winter pp. 101-132)

BIOGRAPHY

BOTANICAL GARDENS AND HERBARIA

CHINA

ROCK ALPINE GARDENS

ROSES

SCIENCE—BOTANY

SOILS

TREES AND SHRUBS

TURF

VEGETABLE GARDENING

AUTHOR INDEX 1982

ARTIST INDEX 1982

PHOTO CREDITS

Denver Botanic Gardens, Inc.
A Non-Profit Organization

Correction: The last sentence p. 77, Autumn 1982, *The Green Thumb* should read, "With an available area of 10,000 square meters, . . ."

Illustration Sources

Front cover: Drawings by Frances Frakes Hansen
Pages 102-103,126: Photographs, *The Green Thumb* files
Page 105: Photograph by Velma Richards
Page 106: Photograph by Panayoti Peter Callas
Page 108: Drawing by Doris Peacock
Page 109: Drawing by Charles Edward Faxon from Sargent, *The Silva of North America*, 1890
Pages 114-115,120-123: Drawings by Niki Threlkeld from *Plants of the Southwest Catalog*, 1982
Pages 116-117,119: Drawings by Phil Hayward
Page 124: Drawing by David Deardorff
Page 128: Drawing, *The Green Thumb* files
Page 130: Photograph by Josephine Robertson

The Green Thumb
Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

NON-PROFIT
ORG.
U. S. POSTAGE
PAID
Permit No. 205
Denver, Colorado

Do Not Fold